22 DECEMBER 1960

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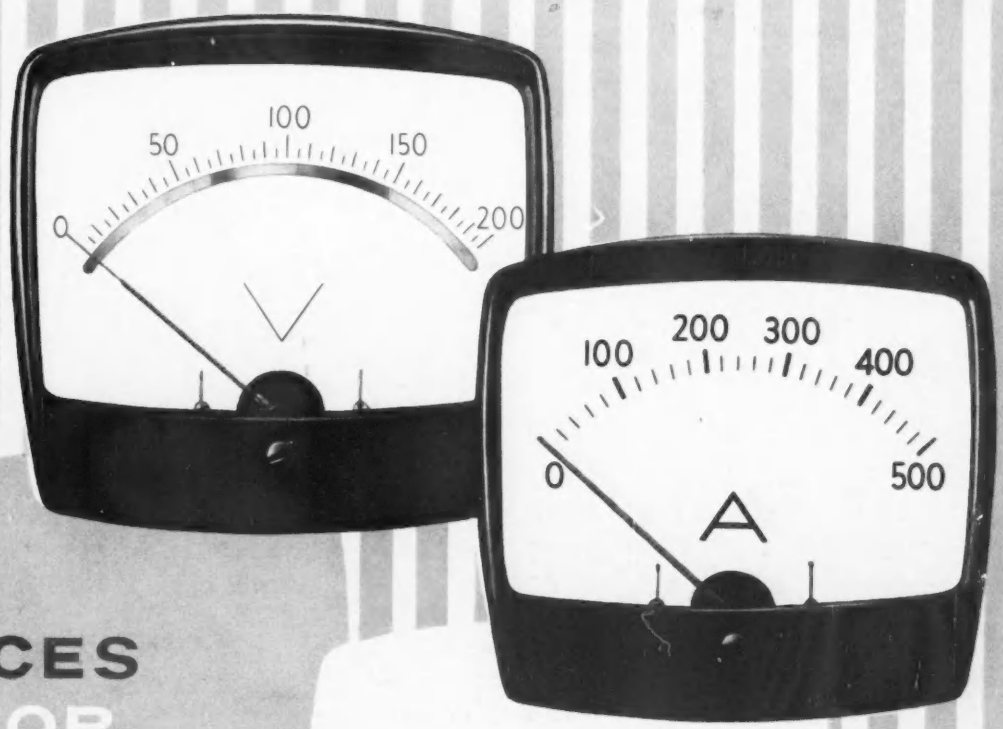
ELECTRICAL TIMES



FACES FOR CASES

Elegant cases and legible faces give these Ferranti Style 'A' instruments a contemporary look but they are more than good looking! Robust in construction, and designed to give minimum rear projection, they are interchangeable with standard 2½" and 3½" round flush instruments and are available with fine scale with or without mirror or bold scale.

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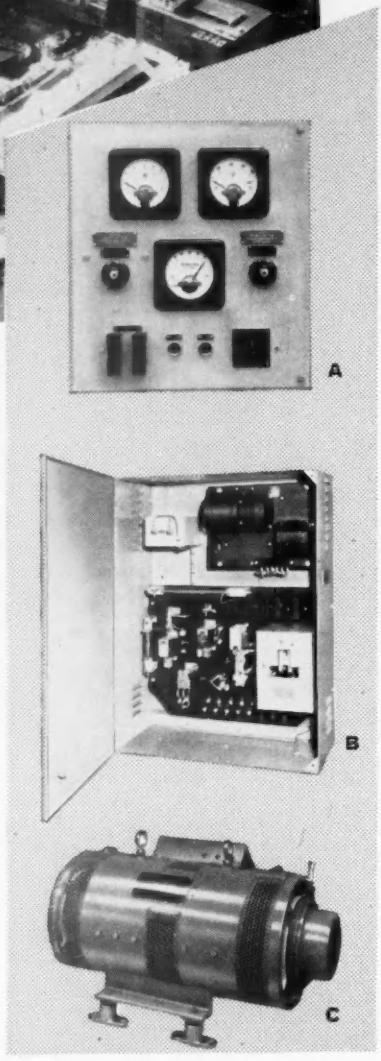

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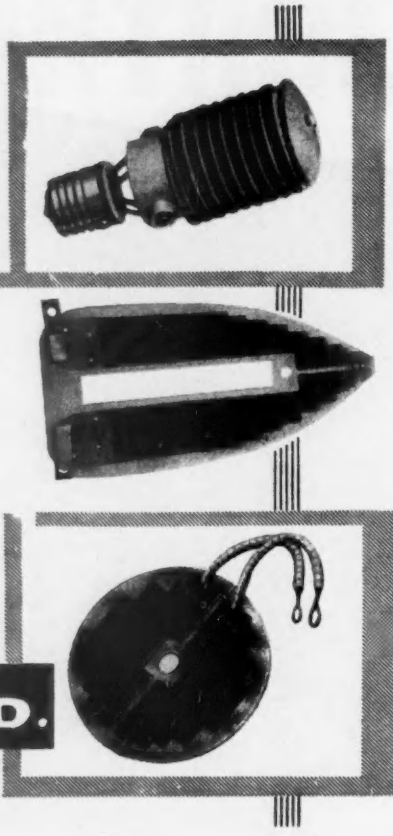

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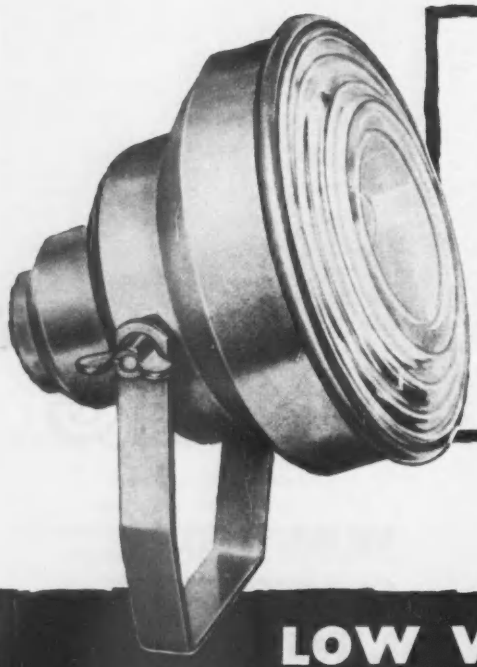

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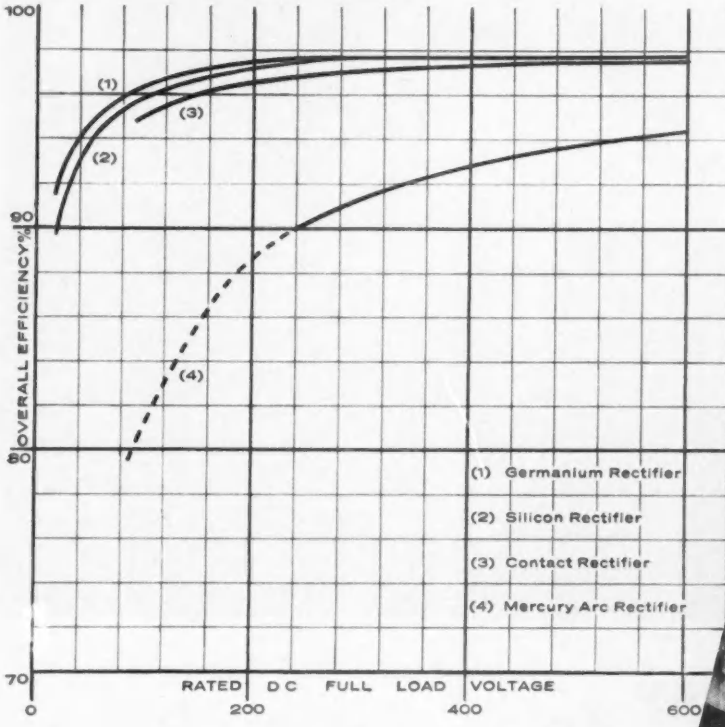

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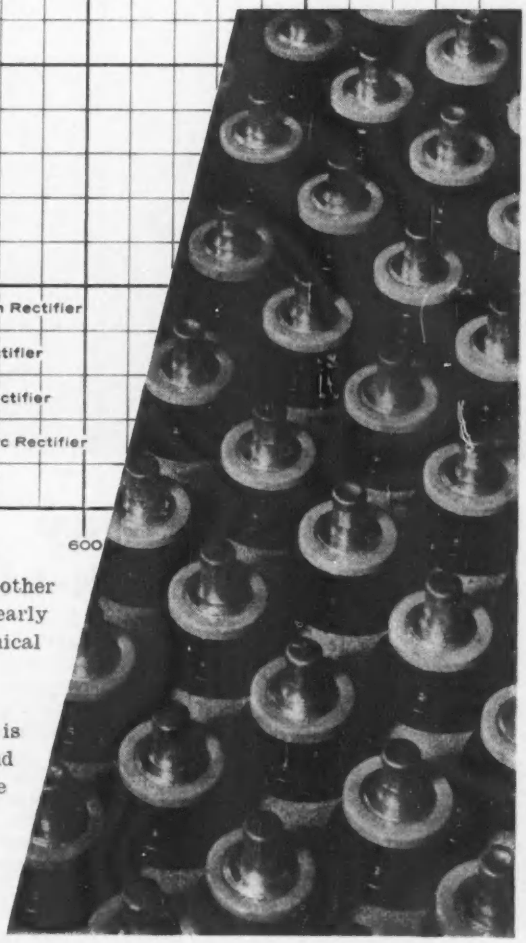

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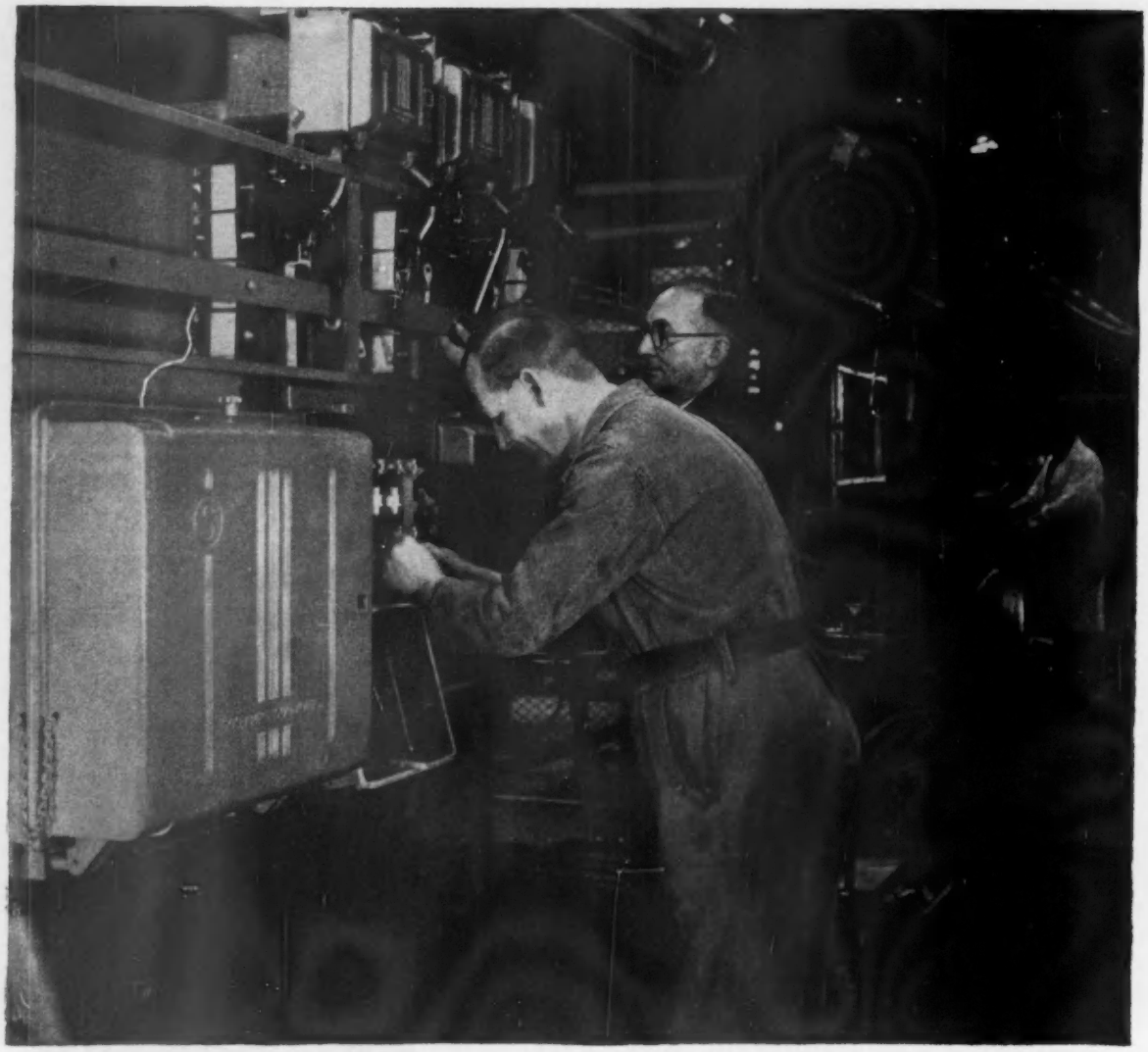

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NEWS SHEET

CEGB postpones decision on Hamstead, IoW, nuclear station site, although it is fully satisfactory technically. Earnley ruled out as possible alternative. If Hamstead is abandoned, only alternative for south coast supplies is long distance transmission or expensive coal generation. (949, 971)

Short-circuit rating of cable becomes a distribution design factor with higher prospective faults. Cable limits of 160°C for conductor and 250°C for sheath recommended in IEE paper. Thermal expansion and bursting effects most important. (949, 957)

Supply industry witnesses give evidence in transformer RTP case. There will be concern about quality if prices fall too low; but some area boards buy more from non-TMA members than from member firms. (970)

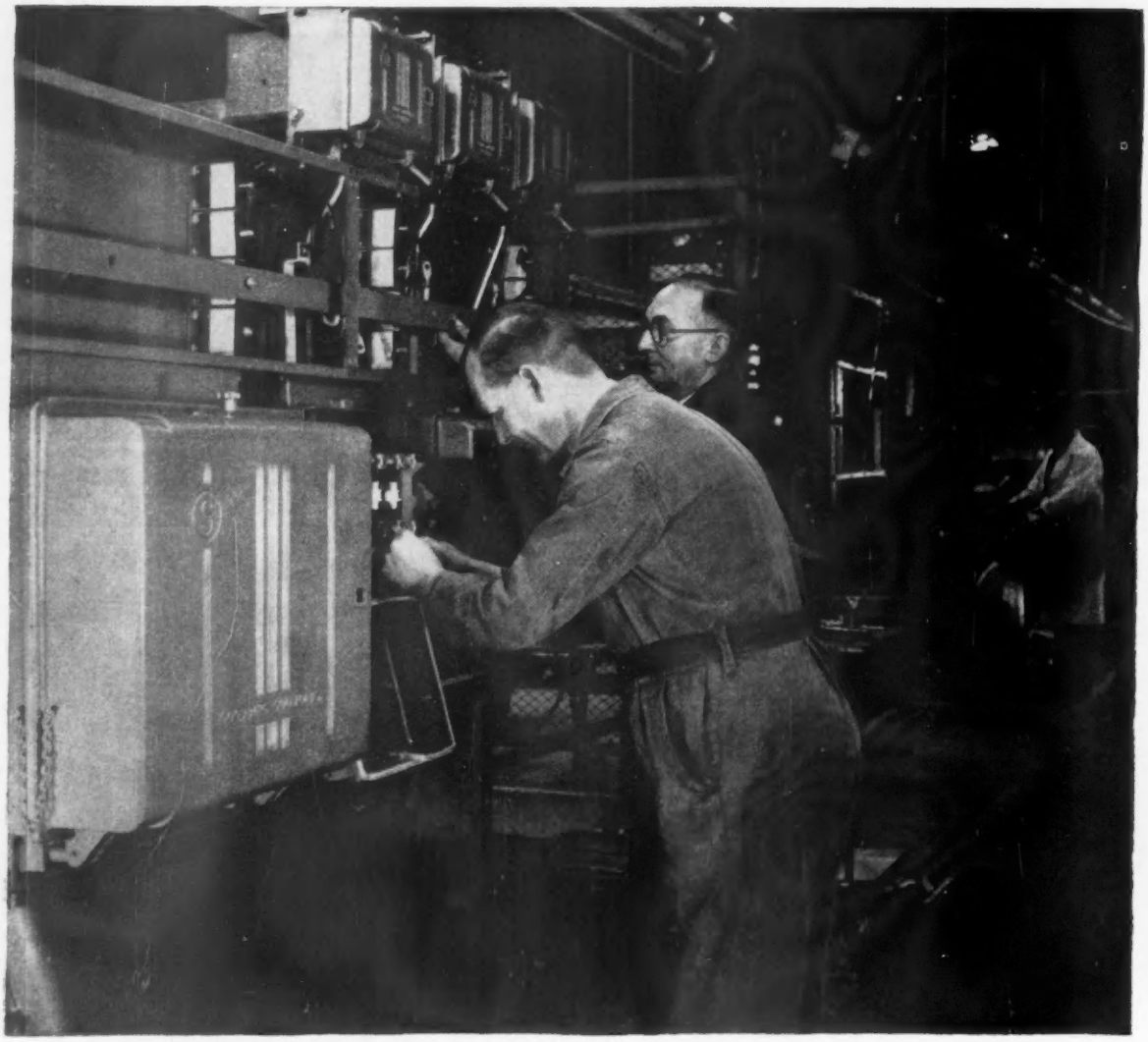
All-glass fluorescent starter switch evolved by AEI, suitable for tubes up to 80 W and measuring only 1 in. long by $\frac{3}{8}$ in. diameter. (974)

Insulation life in electrical machines much influenced by cyclic loading argues Israeli professor in studying variation of insulation life expectancy with temperature. (950)

Salisbury contractor wins right to refuse to register apprentice while observing terms and conditions of National agreement and working rules in electrical contracting industry. (972)

DSIR report on shipbuilding industry suggests electrical firms important through possible manufacture of marine turbines with more attention to research and development than specialist firms give. (950, 974)

PEOPLE—In ERA promotions L. Gosland also becomes deputy director and C. G. Garton and E. W. Golding assistant directors . . . R. W. Dowsett appointed director of MK . . . D. Bellamy reappointed chairman, YEB, for one year . . . J. P. V. Woollam becomes deputy chairman, Simon-Carves . . . A. E. Woollaston succeeds F. N. Skinner (retiring) as managing director, J and P (Australia) . . . R. Morgan becomes home market sales director, Morphy-Richards (Cray) and A. W. Sinclair is sales director, Morphy-Richards (Astral) . . . G. E. Lowe (chief engineer) and A. R. Rumfitt (tech. sales manager) become special directors, Yorkshire Switchgear and Engrg. Co. . . . R. C. Ray promoted to sales manager, Wild-Barfield Electric Furnaces . . . Reyrolle chief engineer W. Gray co-opted a director . . . E. R. Acraman joins board of Pope's Electric Lamp Co. . . . Retirements include T. E. H. Birley (BICC deputy overseas manager) and P. E. Wheatland (deputy manager, GEC Installation Div.) . . . J. S. Yates promoted to deputy chief eng. YEB. (962-964)



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NEWS SHEET

Conjugate-impedance network analysers are used in standard design for area boards and CEGB divisions and regions. Accuracy to within 2% of calculated values secured with economy in construction. (951)

67 electric multiple unit trains withdrawn from service in Glasgow on recently opened Airdrie to Helensburgh line. Second fault followed explosion which injured seven people, both due to transformer failure. Public enquiry opens today. (971)

Resistance heating in North American houses proving increasingly attractive, says correspondent. Cost perhaps 20% higher than electric plus oil but saving on cleaning compensates. (956)

CEGB choose Landguard Point, Suffolk, as possible site for power station; size and type as yet undecided. Negotiations proceeding. (971)

Sixty-ton floating crane has diesel-electric propulsion; twin 400-h.p. propeller motors supplemented by 200-h.p. bow steering pump. 130-h.p. crane hoists lift 60-ton loads at 78 ft radius. (965)

New organisation incorporating US, Canada, replaces OEEC. Due for operation next year. Eighteen European countries members. (950)

Brushless alternator with stationary field windings and stator described in recent patent specification. Only moving part is inductor assembly, rotating in annular space between field and stator. (960)

Stock Exchange manipulations played part in Vactric failure, alleges MP. But President BoT refuses enquiry at present. (973)

Research at Imperial College covers supply system control problems, and electrical machines in terms of detailed electro-magnetic characteristics. (973)

BUSINESS—Thorn Electrical Industries create £3m. new loan stock . . . Kenwood profits improving . . . Spark Holdings increasing capital to permit further acquisitions. (976) . . . A.C. Scott acquired by Range Boilers. (971)

OVERSEAS—In Canada, severest ice in 50 years on Winnipeg river may cause power cuts . . . First decision on allowing Canadian power export to US expected soon . . . 2,500 MW hydro station completed in USSR . . . In Australia consultants recommend power system merger . . . Ferranti win £400,000 transformer contract for NSW Vales Point station . . . Australian aluminium plant plans will require large power requirements in Queensland. (961)

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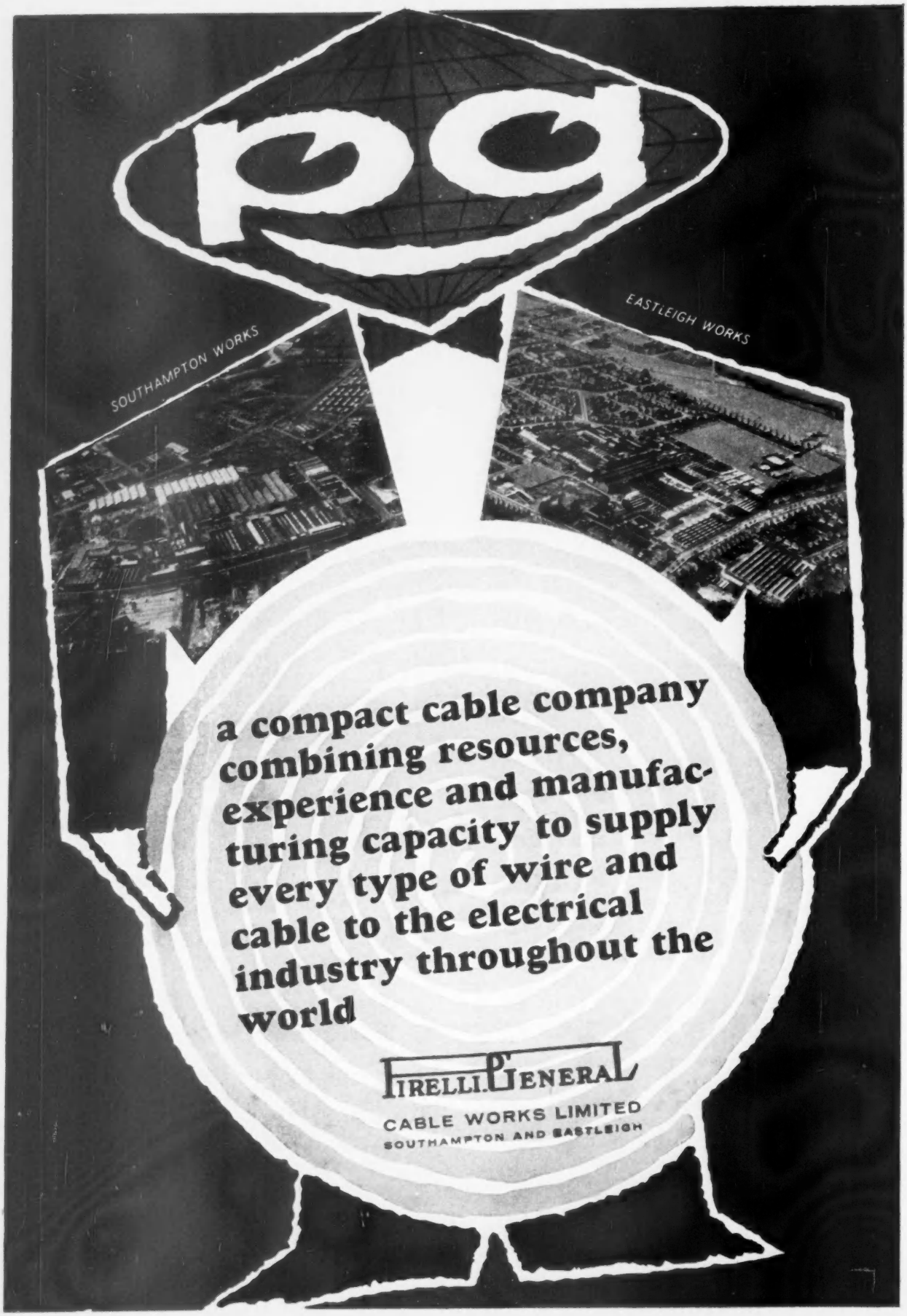
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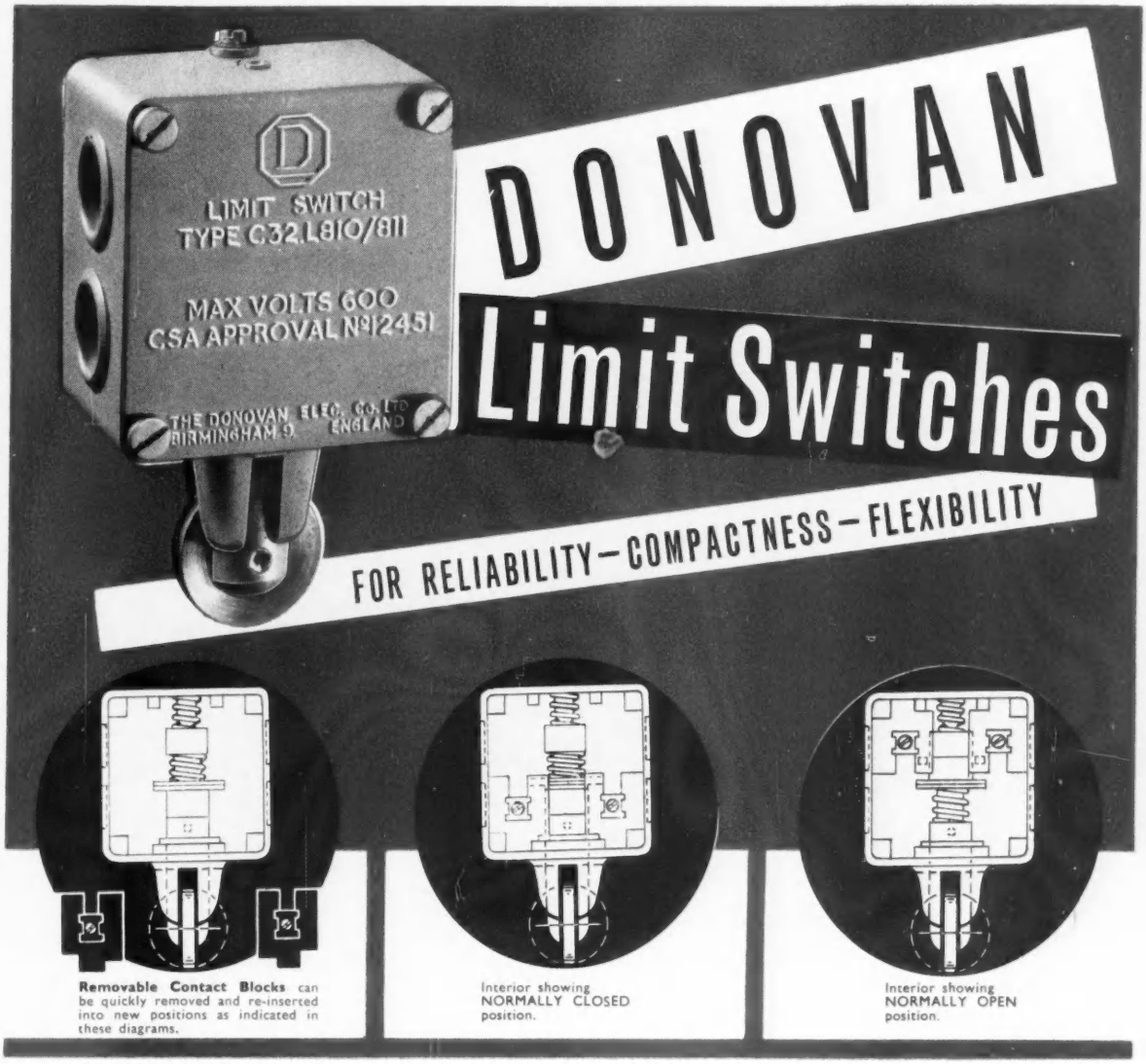
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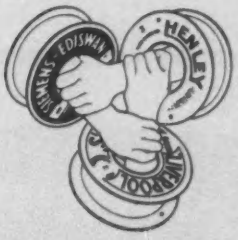

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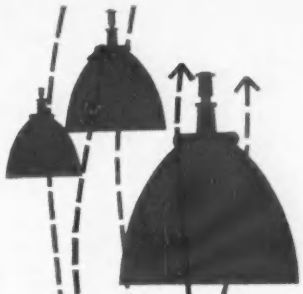

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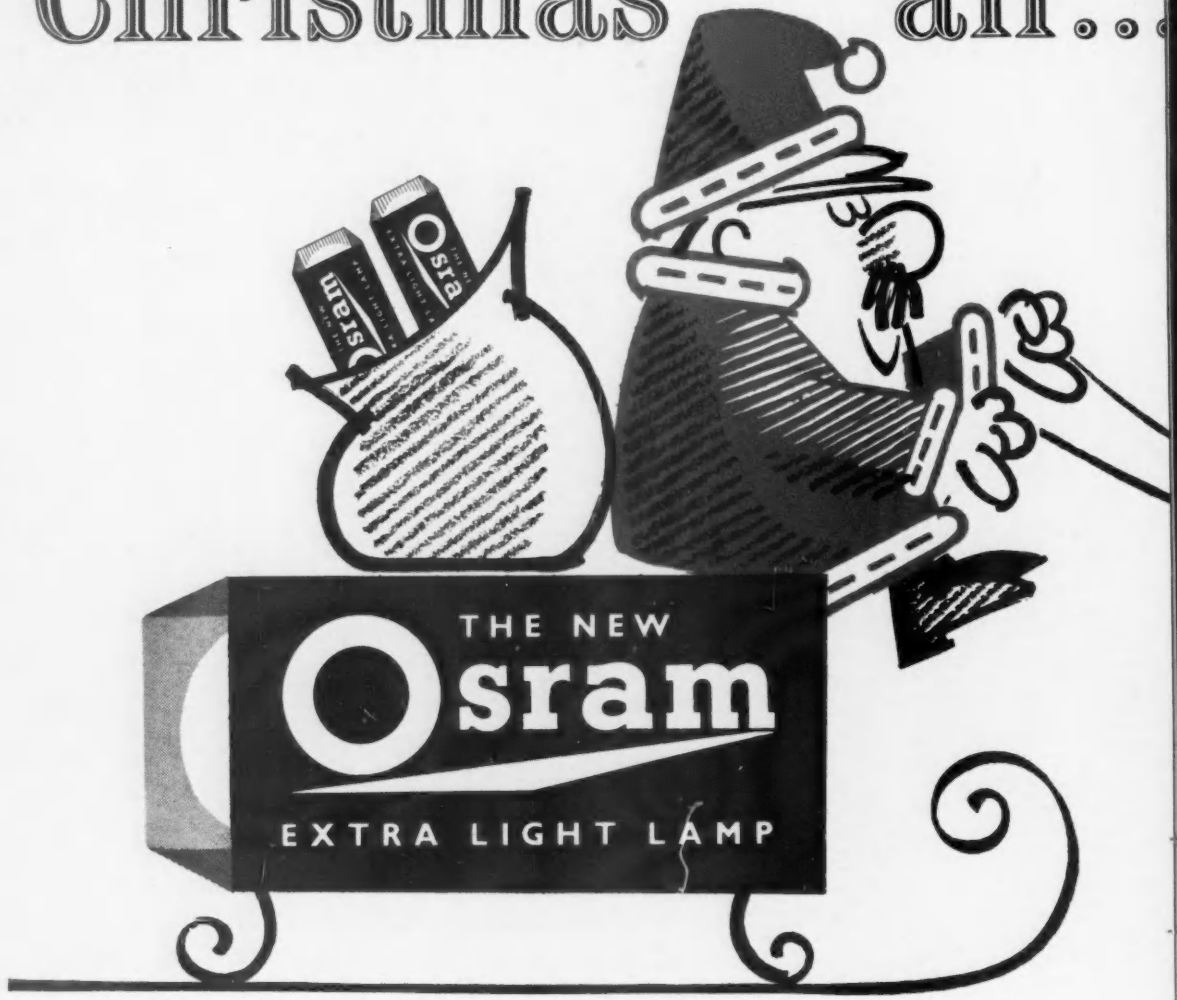

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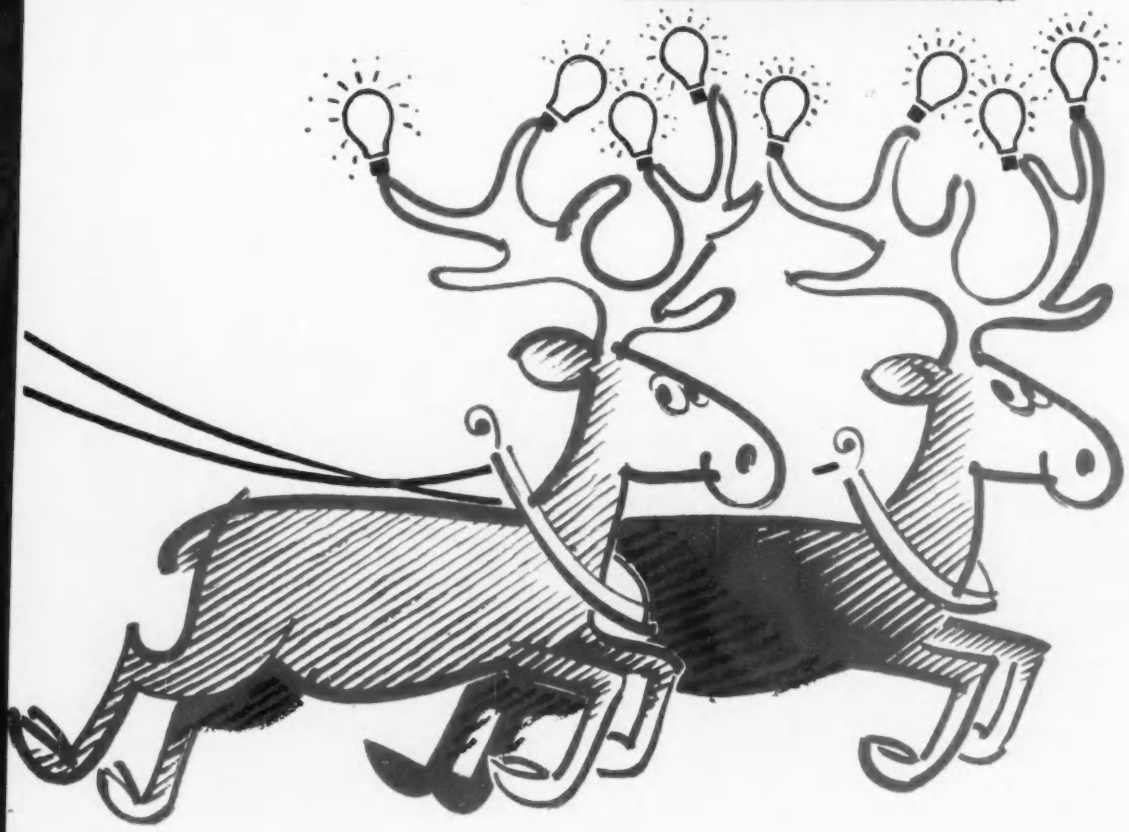

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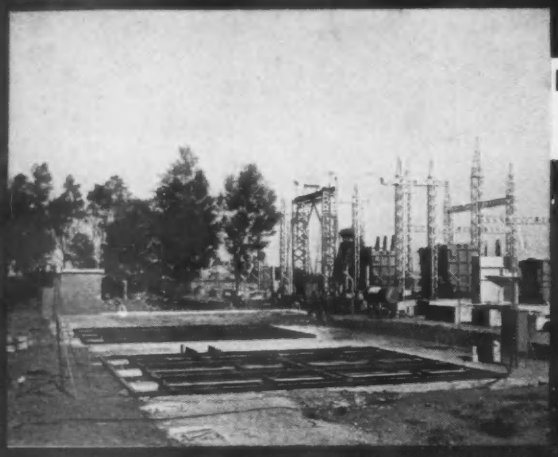
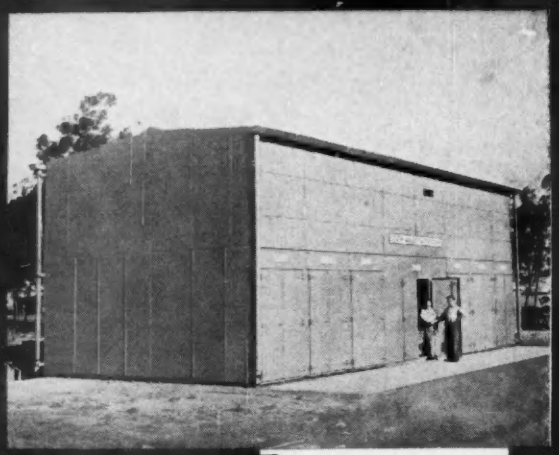
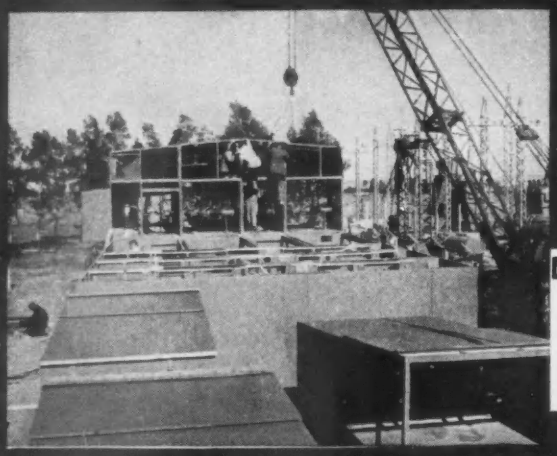


A 33kV duplicate busbar 'package' substation. Concrete plinth and base frame—after 2 days.



C 33kV duplicate busbar 'package' substation —complete after 21 days.



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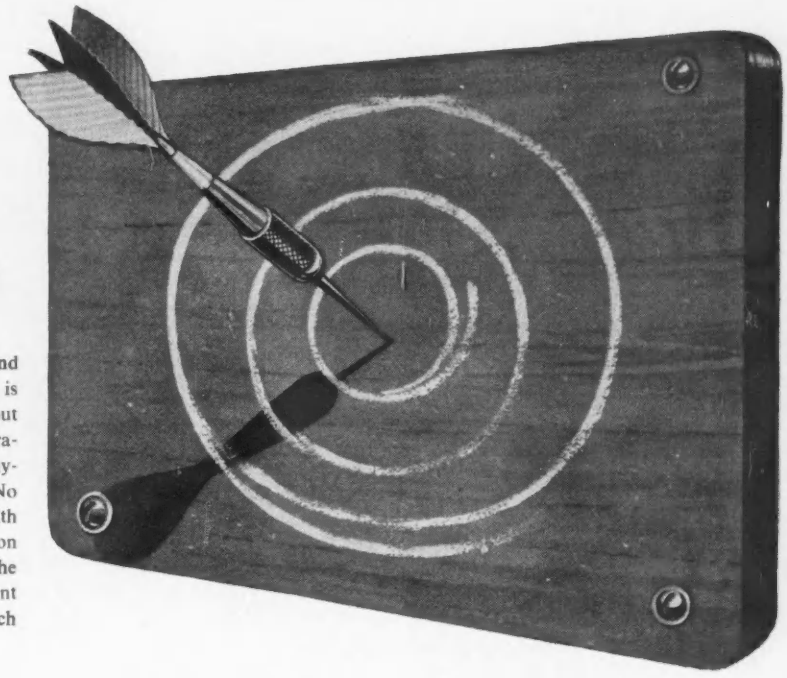

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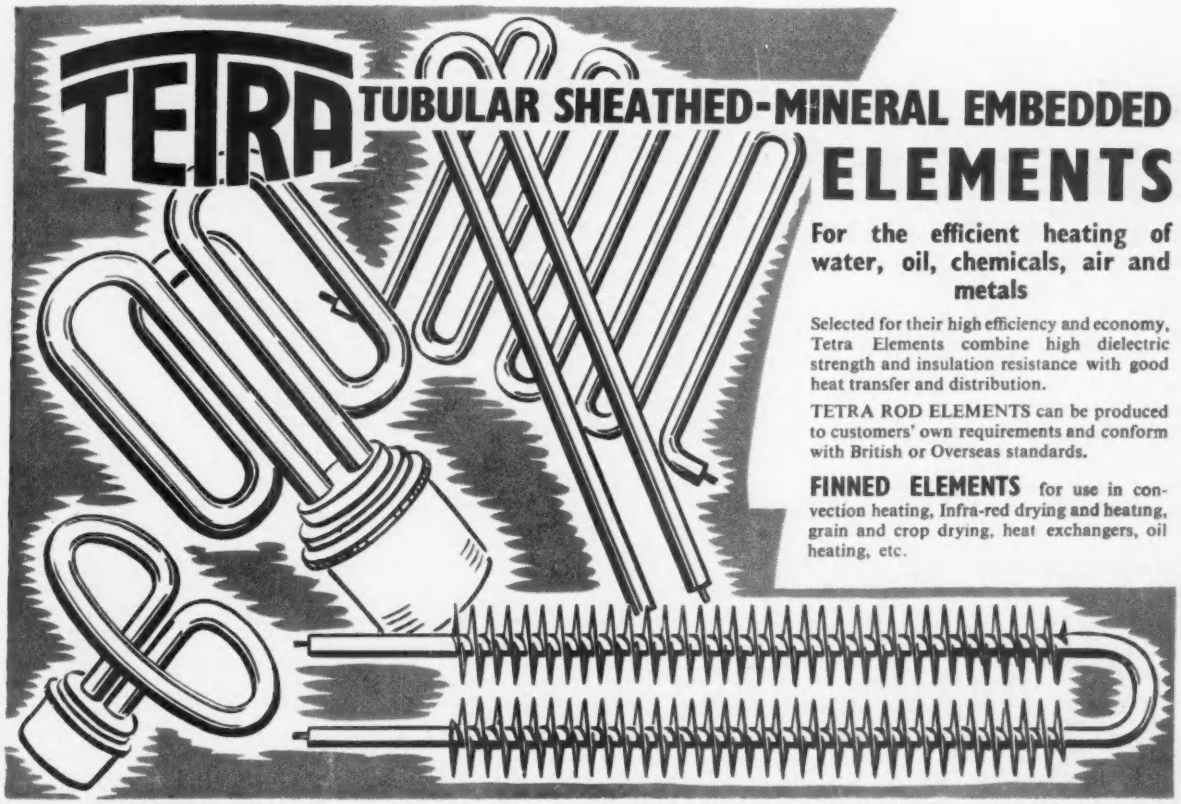

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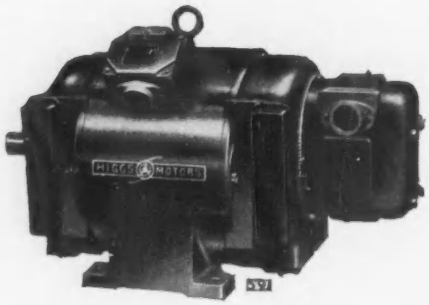

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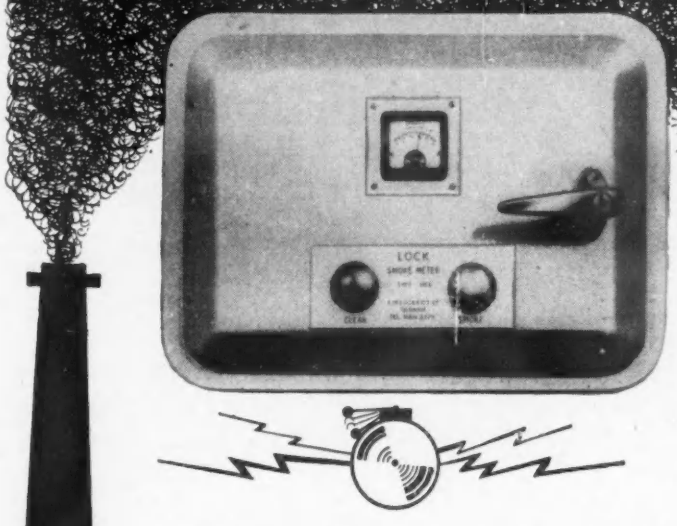

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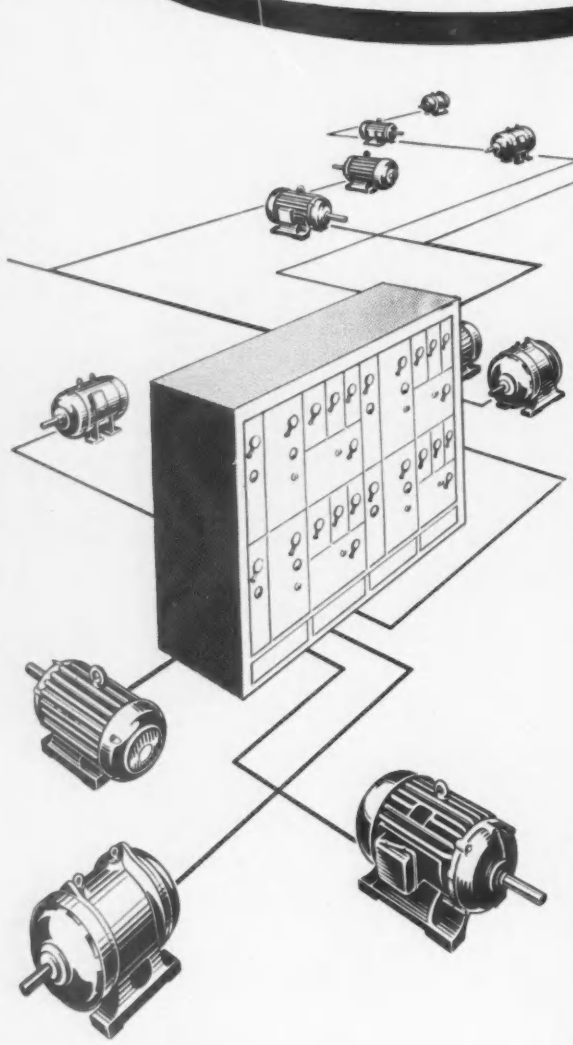

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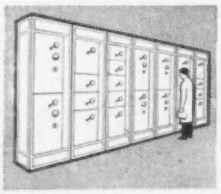

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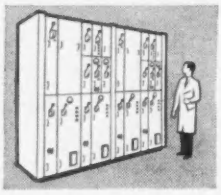

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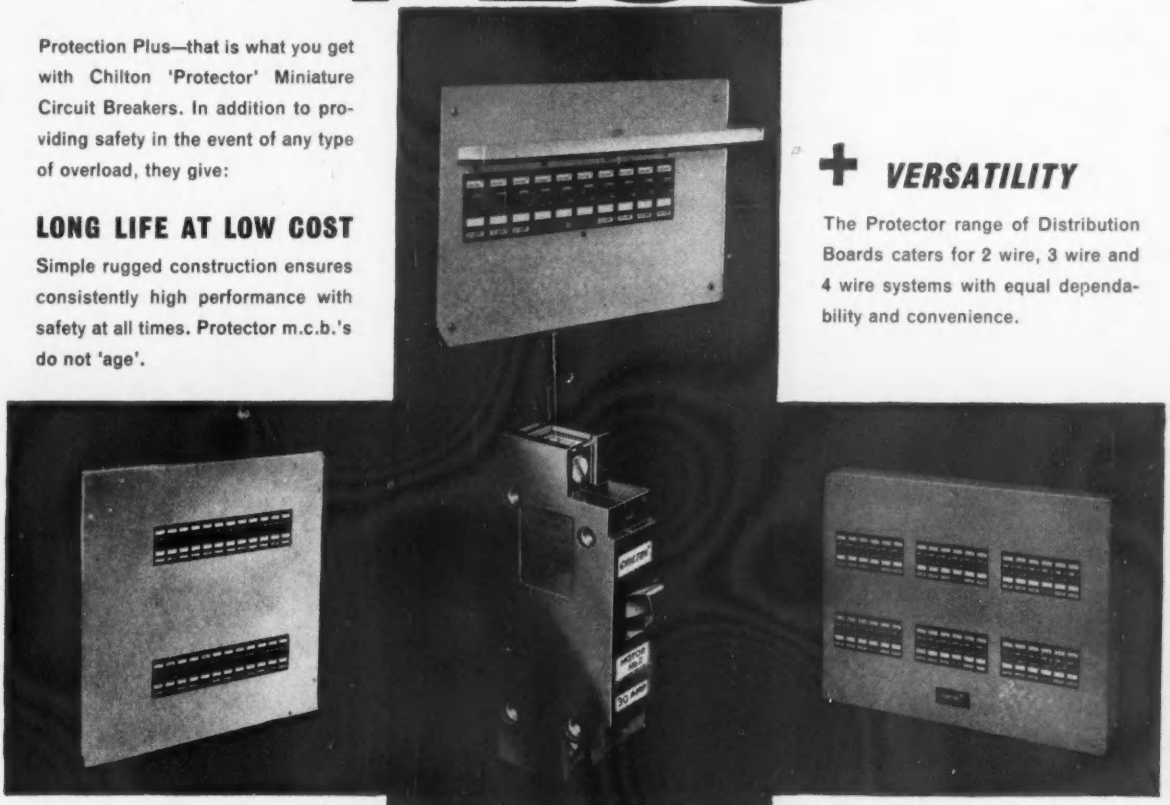

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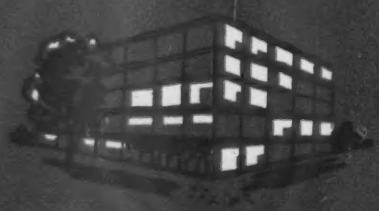

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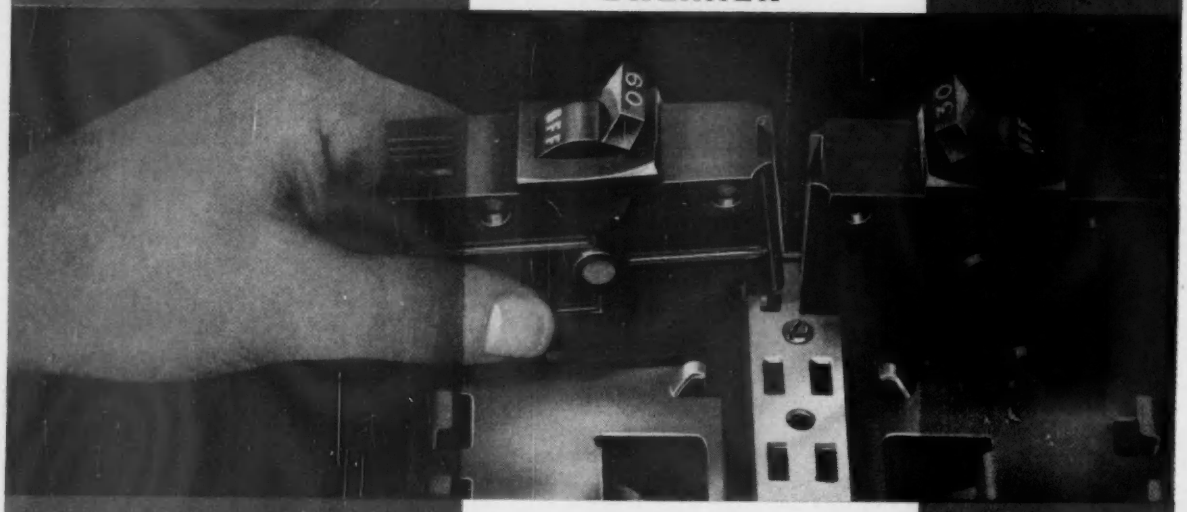

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Photograph by courtesy of Ford Motor Company Ltd.
The lighting scheme was planned by Posford, Pavry & Partners, Consulting Engineers, and installed by Rashleigh, Phipps & Co. Ltd.

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Well-lit factories are essential for increased production. Lighting these factories is an achievement of which Revo are proud.
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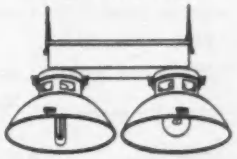

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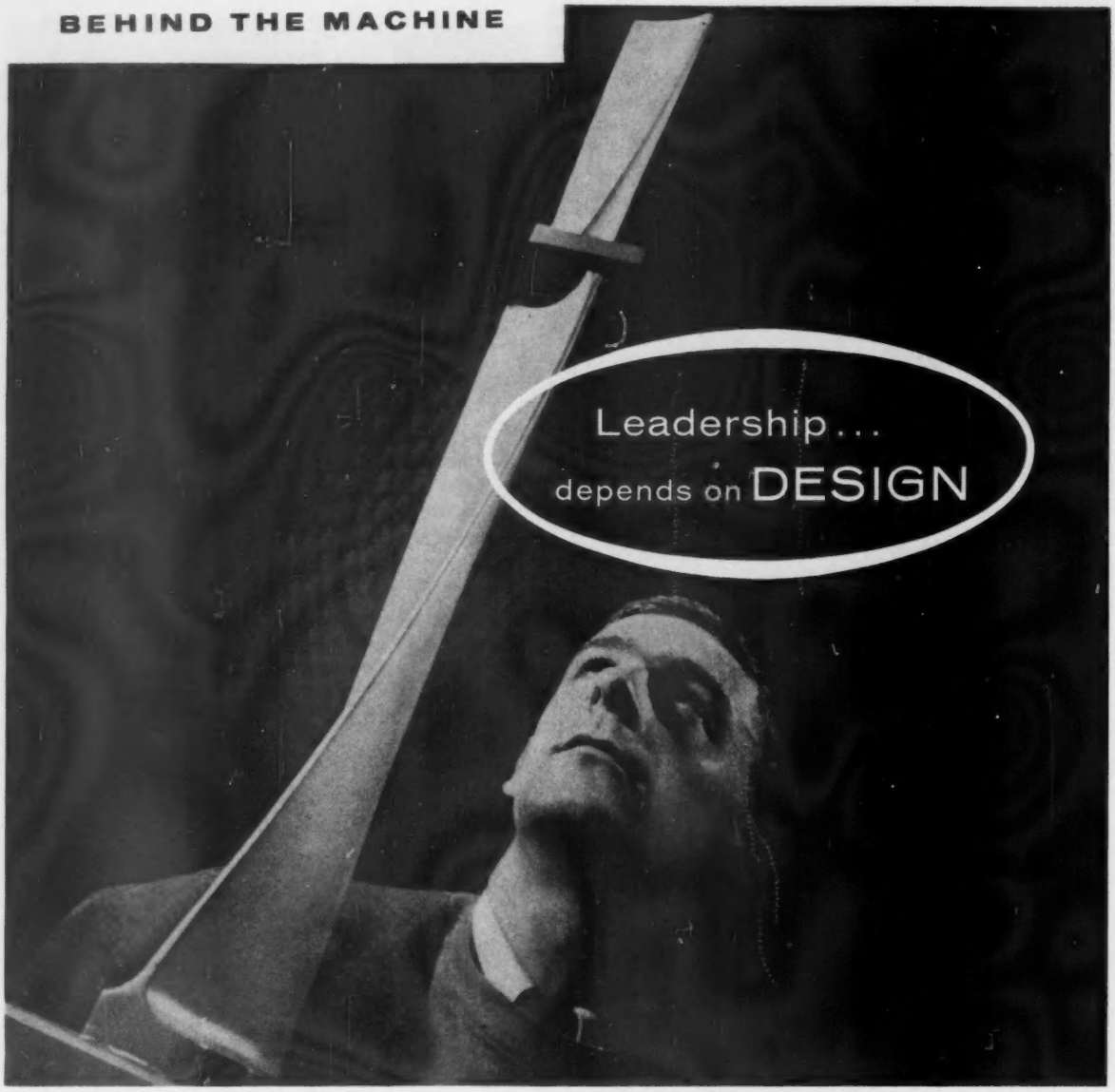

THE THREE POWER STATIONS WITH THE GREATEST AVERAGE, OVERALL EFFICIENCY IN ENGLAND AND WALES FOR 1959 WERE EQUIPPED WITH AEI TURBINE-GENERATORS

Close on nine hundred professional engineers and draughtsmen in the Turbine-Generator Division of AEI are engaged in the task of designing more efficient machines. In this work a balance must be kept between the theoretical aims of the research worker and the practical requirements of the factory. That this balance is held successfully is one reason why AEI is ahead.

Shown here is a representation of the two-tier turbine blade design. This is a feature of the well-known Baumann exhaust system —patented by AEI—an ingenious yet simple method of increasing the turbine exhaust area without increasing the length and mean diameter of the last blade. For every size of turbine, AEI engineers are the people to talk to. It pays to see them early when planning new installations.

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THURSDAY 22 DECEMBER, 1960
Registered as a Newspaper Volume 138 No. 25

ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

Analyseurs de Réseaux—3e Partie **951**

Les analyseurs de réseaux employés pour l'étude des problèmes des systèmes de distribution qui sont d'un caractère essentiellement local sont du type courant alternatif à impédance conjuguée. Ils opèrent des canalisations publiques de 50 Hz par l'entremise de stabilisateurs de tension, mais ils représentent les inductances par des condensateurs, et des capacitances par des inducteurs. Des unités standard ont été mises au point pour représenter les génératrices, les impédances de lignes et les impédances de charge. Il a été découvert, au cours des essais, que la plupart des données mesurées étaient en deça des limites ± 1% des valeurs calculées.

Caractéristiques de Court-Circuit des Câbles ... **957**

Pour les câbles de systèmes de distribution, il est nécessaire de spécifier une valeur de courant court-circuit qui puisse être maintenue pour une courte durée, sans causer de dommages sérieux aux câbles ou joints associés. Des recherches effectuées au Royaume-Uni ont établi de nouvelles valeurs pour les types standards de câbles. Pour des câbles ayant une capacité maximum de 11 kV, des limites ont été établies à cause du dommage des joints, causé par l'expansion thermale des conducteurs, dommage aux gaines de plomb par la chaleur et, dans le cas des câbles multiâmes, l'éclatement du câble par les forces magnétiques.

Calculs pour l'Erection de Lignes **966**

La méthode généralement adoptée pour l'érection d'une ligne aérienne de transmission est l'emploi de portées équivalentes. Une autre alternative est d'effectuer une tension sur les conducteurs tout le long de la ligne, tension équivalente à celle de la ligne complète. Si cette seconde méthode est employée, il faudra vérifier soigneusement que la tension de régime permise ne soit pas excédée inconsciemment.

In dieser Nummer

Netzüberwachungsgeräte, III **951**

Die zur Untersuchung von örtlichen Versorgungsproblemen verwendeten Netzüberwachungsgeräte haben konjugiert-komplexe Wechselstromwiderstände. Obwohl sie durch Spannungsgleichhalter an 50 Hz Versorgungsnetze angeschlossen werden, verhalten sie sich induktiv gegenüber Kondensatoren und kapazitiv gegenüber Induktoren. Genormte Einheiten sind entwickelt wordem, die jeweils Generatoren, Leitungsimpedanzen und Belastungsimpedanzen darstellen. Nachprüfungsergebnisse haben gezeigt, dass die meisten mit diesen Geräten gewonnenen Messwerte bis auf ± 1% mit den errechneten Werten übereinstimmen.

Kabel-Kurzschlussleistung **957**

Bei Kabeln für Verteilungsnetze muss die kurzzeitige Kurzschluss-Belastbarkeit des Kabels und der angeschlossenen Verbindungen angegeben werden. In Grossbritannien durchgeführte Forschungsarbeiten haben zur Aufstellung neuer Kennwerte für genormte Kabeltypen geführt. Bei Kabeln mit einer Belastbarkeit bis zu 11 KV stellt die durch die Wärmeausdehnung der Leiter verursachte Beschädigung der Verbindungen einen begrenzenden Faktor dar. Weitere begrenzende Faktoren sind die Wärmebeschädigung von Bleiumhüllungen und bei Mehrfachleiterkabeln das Sprengen des Kabels durch magnetische Kräfte.

Das Errechnen von Freileitungen **966**

Die übliche Methode der Freileitungserrechnung ist auf Grund des Begriffs der sogenannten " Ersatzspannweiten ". Andernfalls werden Leiter auf der ganzen Strecke im Einklang mit der Spannung der vollausgeführten Leitung gebracht und in diesem Falle ergibt sich die Notwendigkeit, daraufhin zu prüfen, dass die zulässige Betriebsspannung nicht unwissentlich überschritten wird.

Network Analyser Installations—Part 3 ... ... **951**
by A. W. Hales, A.C.T.(B'HAM), A.M.I.E.E., A.M.BRIT.I.R.E.

Cables Under Short-circuit Stress **957**

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Conductor Stringing Calculations **966**
by E. M. Clackson

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REPEAT SET COMMISSIONED AT LYNTON NOVEMBER 1960

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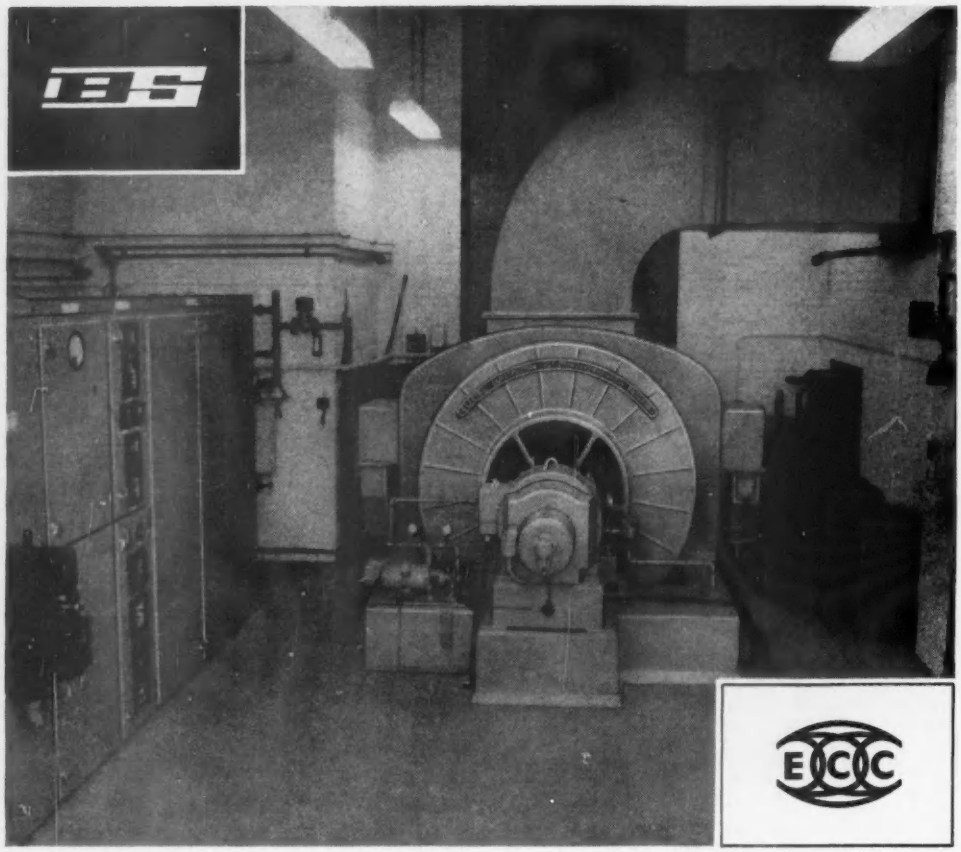

"The next set is in course of preparation for S.W.E.B."

COMMISSIONED AT PRINCETOWN DECEMBER 1959

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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 22 DECEMBER, 1960

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T. W. WRIGHT

Comment

We wish our readers a Merry Christmas and a Happy New Year

CABLE FAULT CAPACITY

How much copper needs to be put into a distribution circuit may be determined by fault current rather than load current. This is becoming increasingly a factor to be considered in distribution system planning, and two papers presented to the IEE last week provided the industry with an important addition to reliable information on this question. For example, as loads become larger, distribution engineers are finding it difficult to keep within the accepted 150 MVA limits on 11 kV feeders. Switchgear manufacturers can manage 250 MVA without difficulty; but what will happen to cable networks if corresponding currents are imposed? MEB chief engineer Mr G. Buckingham, in a practice-packed paper extending to day-to-day engineering the research results of the ERA, painted some frightening pictures of burst sheaths and wrecked joints if safe limits were exceeded; but he was reassuring to the extent that the newly established short-time fault-current carrying capacities are in most cases more generous than those to which distribution engineers should have been working in recent years. It is reassuring, too, to consider that the risk of finding too much copper uneconomic is limited in the present fast-growing demand situation. Overall, however, it seems that just as the cable engineer has got used to designing dielectric whose thickness is determined more by switching and atmospheric over-voltages than by system working voltage, so must he become more accustomed to basing copper cross-section on fault currents rather than load currents. Establishment of the new safe values for copper, lead and conventional joints will make engineers impatient for the promised extension to deal with aluminium and mechanical connections.

SOUTH COAST GENERATION

What factors are to determine generation costs for central southern England? The question is raised by the CEGB's rather ambiguous statement, issued last week, that they are not going to press at present for consent to build a nuclear station at Hamstead, on the Isle of Wight. This decision has been reached because of concern about the amenity angle; technically, Hamstead has been found "excellent" for a Magnox-type nuclear station (despite the submarine cable link that would be involved), while the Sussex alternative previously advanced, Earnley, has been found unsuitable for any foreseeable type of nuclear station. But having decided

against proceeding with the Hamstead site immediately, the Board seem to have no alternative policy. Their statement merely rehearses the difficulties. To generate in the Midlands would be possible but would mean more (and unpopular) transmission lines; and more stations for the Midlands, where they are as unwelcome rurally as in the south. To put a conventional station on Southampton Water would be feasible, but the high fuel cost makes it economically questionable, if oil is considered politically unacceptable. Between Dungeness and Weymouth the south coast has no potential sites for Magnox reactor nuclear stations that even satisfy preliminary requirements. How to cut this Gordian knot while southern county power demand goes on increasing at a rate faster than the national average? Perhaps the answer lies in development of more advanced types of nuclear stations, particularly the advanced gas-cooled reactor. Sir Robertson King estimated last summer that not more than nine stations are likely to be built by the CEGB of the Magnox reactor type. The recently announced Wylfa will be the eighth. Advanced gas-cooled reactor stations might face less severe siting requirements than current nuclear designs and so be a possibility on the south coast. In that case the CEGB delay in decision might mean that Hamstead could be left in peace without the electricity consumers of the Southern Electricity Board having to pay heavily for it through the operation of the bulk supply tariff. The only feasible alternative would seem oil, despite the opposition mining-area-MPs would advance. In the short-run, that may be the most practical solution.

INSULATION LIFE

Most engineers have a rough idea that an increase in temperature of about 10°C will halve the life expectancy of electrical insulation, the exact value of the ratio depending on the class of insulation involved. They are not so likely to be conscious, however, of the extent to which the relationship is affected by the varying temperatures that accompany cyclic loading and short-time overload. A paper by Dr J. Ben Uri in the somewhat recherché Part C of the *IEE Proceedings* makes this point with some force, through calculations based on experimental work which is at the basis of the halve-per-ten degrees rule. It is not only the relatively short time at the highest temperature that acts to reduce life, it is the relative slowness of the return to nominal temperature. As a result, average temperatures, usually considered in applications of the insulation life rule, give results of life expectancy well in excess of what strict application of a temperature-time summation shows. This situation would be the more worrying if there were any widespread experience of premature breakdown of insulation due to designers working to average temperatures without making sufficient allowance for short-time overloads. Such trouble is not prevalent, a situation which Dr Ben Uri attributes to relatively low permitted temperatures having been allocated to the various classes of insulation. In this respect, the present generation of engineers are not the first to have benefited from a built-in factor of safety.

TROUBLE ON THE LINE

Faults serious enough to cause substantial numbers of trains to be taken out of service have dogged two of the most recent rail electrification schemes. Those on the Eastern Region appear susceptible to relatively easy rectification; in Scotland, the faults were accompanied by a serious accident, and, to judge by preliminary reports, are likely to involve a more time-consuming modification. There can be no denying the seriousness of these developments to the hopes built round the 25 kV, 50 c/s electrification system developed in Britain. Because the Scottish incident is to be the subject of a statutory inquiry, it is difficult to comment on precise technical details, although the significance of the transformers being involved will not be missed. What is necessary now is the fullest public account, at the right time, of the engineering explanation for the troubles, so that the extent may be defined to which they are peculiar to the British system of two-voltage working and limited clearances, and the completeness of the cure made evident. A situation such as this, involving more than one great manufacturing concern in the electrical industry, can be retrieved only by frankness. The 25 kV, 50 c/s system is a pioneering concept in many ways, and trouble is common enough in such cases, as the aircraft industry, for example, knows well.

SUCCESSOR TO O.E.E.C.

Formal signing of the documents which next year will bring into being an Organisation for Economic Co-operation and Development marks a pause rather than an end in the work of the Organisation for European Economic Development, which body it will replace. The principal difference between the new Organisation and the old is that it will explicitly include Canada and the USA, so essential to any consideration of Europe's trading problems, rather than have them present in observing capacities. Many of the committees of OEEC are to continue their work largely undisturbed, so continuance can be hoped for of the valuable series of statistics which have come from this quarter, as well as for some of the annual surveys, and the occasional special studies which have helped so much in the overall evaluation of power policy in Europe. Achievements of OEEC in its 12 years' existence includes much for which those who have worked for it can be proud, nowhere more than in relation to the electricity industry. Building on such a tradition of usefulness and of progress in practical things without undue political interference, the OECD, as we must learn to write this old/new body, must have high hopes of success.

This week's quick summary of electrical news faces advertisement page 4

Network analyser installations

REGIONAL, DIVISIONAL AND AREA BOARD ANALYSERS

PART 3

by A. W. Hales,* A.C.T.(B'ham), A.M.I.E.E., A.M.Brit.I.R.E.

THE two preceding articles of this series related to the network analyser installation at the Central Electricity Generating Board's headquarters. This third (and concluding) article deals with a.c. network analyser installations of a type developed by the Board's headquarters, and which is in use in various regional, divisional and area board headquarters throughout the country.

These analysers are intended more specifically for the study of problems of an essentially local character. The necessity for the provision of such equipment was occasioned principally by the increasing complexity of supply systems at all voltages and the number of problems that were being encountered requiring solution on an a.c. network analyser. Thus, there arose a significant demand from system design engineers to have their own analytical equipment immediately available.

A working party of the then Central Electricity Authority and the electricity boards was given the responsibility of conducting an investigation into the feasibility of making available a.c. network analysers which, whilst having the desired operational facilities, were of low initial cost. The working party, after carrying out a review of past and current activities in the sphere of network analyser design and construction, decided that to proceed with the development of an equipment based on then-existing designs would, of necessity, be expensive, and furthermore, it would be difficult to meet the desired specification. The specification required that the following conditions be fulfilled, consistent with economic production:

(a) The equipment should require minimum accommodation space.

(b) It should initially be of a completely "universal" design, readily extensible, and lend itself in individual circumstances to the addition of an economic "geographical" extension.

(c) It should require the minimum of maintenance and be capable of a consistent high level of operational performance without the necessity for frequent specialist maintenance and checking.

(d) The main network instrumentation should be such that it could be calibrated and checked from time to time having recourse to the facilities normally existing in the meter test laboratories of the divisions or area boards.

(e) The analyser should utilise for its network excitation a supply derived directly from the 50 c/s mains, thus obviating the necessity of providing separate oscillator and ancillary amplifier equipment.

(f) The components used in the functional units should be readily available and present no replacement difficulties during the anticipated life of the equipment; neither should they possess critical tolerance values.

(g) The mean overall accuracy of the analyser when applied to system problems for which rigorously calculated solutions are available should be better than ±2% at nominal frequency. The measuring equipment, when considered as a separate entity, should have an overall accuracy of better than ±1%.

(h) The equipment should be applicable to steady-state a.c. power-system studies and synchronous-machine transient-stability studies effected by the step-by-step method.

With this specification as an objective, work on the design and development of a prototype equipment was initiated and subsequently satisfactorily concluded. The design of the production equipments, of which there are now many in operation, was largely based on experience gained from work on the prototype, though there is little similarity between the two categories of equipment.

Some Design Considerations

The direct-impedance type of analyser, when investigated, was found to be unattractive both from the economic, component dimension and supply viewpoints, more particularly when operating at the mains frequency of 50 c/s. A review of possible alternative types of analyser and their respective operational and economic merits was undertaken and it was concluded that the conjugate-impedance analyser showed the most promise as a type on which to

* Mr Hales is with CEGB headquarters. Previous parts of this article appeared on 3 November (p. 667) and 24 November (p. 797). The installations described are the subject of an IEE paper detailed in Reference 1 of Part I.

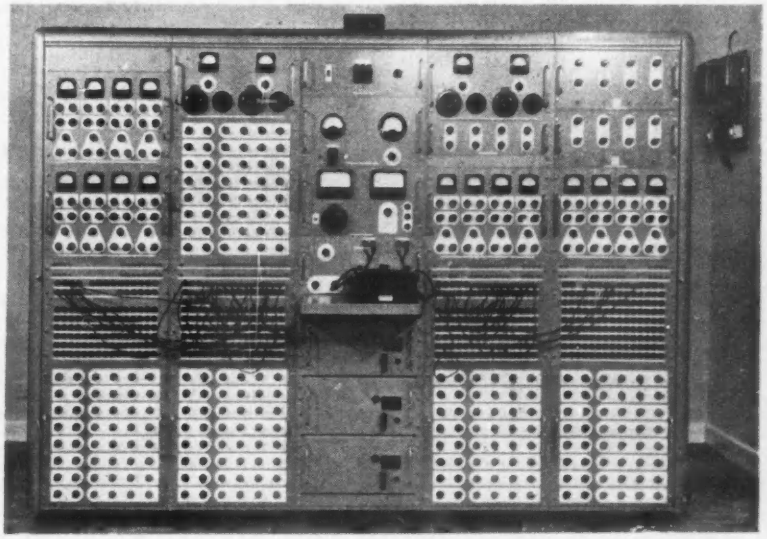


Fig. 10. 50 c/s conjugate-impedance a.c. network analyser installed at the headquarters of the Eastern Electricity Board

base future development work. Accordingly, design and development work on such an analyser—operating directly from the 50 c/s mains supply—was commenced. An analyser, based on this principle, although operating at 120 c/s, has been described elsewhere,* but it is significantly different from the one which is the subject of this article.

The chief differences other than of a constructional nature are as follows:

(a) The use of feedback amplifiers in the generator units is dispensed with.

(b) The metering equipment is designed to enable all measurements to be made with one main instrument, which replaces, functionally, four separate instruments.

(c) The base current and power values employed are half those previously used, while the base frequency of 50 c/s has rendered mains-frequency conversion equipment unnecessary.

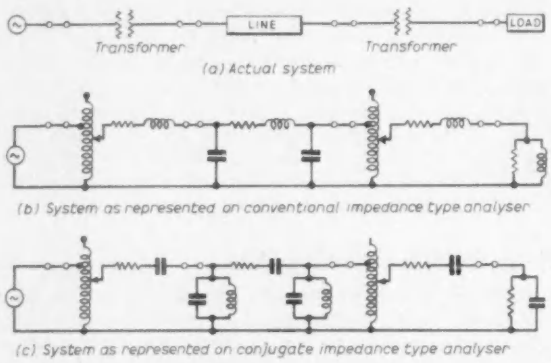


Fig. 11. Representation of power system on conjugate-impedance and conventional a.c. network analyser

The representation of a typical system using the conjugate-impedance principle as distinct from the more conventional direct-impedance principle is shown in Fig. 11. In order to minimise costs, it was decided that uncalibrated network impedance elements should be employed, since this would permit the incorporation of readily available commercial wide-tolerance components, and also simplify subsequent maintenance.

The base operating quantities of the analyser were selected after consideration of the outline design of the various standard units, from which the analyser would be ultimately constructed. Some factors requiring consideration at this initial stage were, for example, the availability of preferred sizes of capacitor and associated tolerance limits, and the operating conditions of the Magslip transmitters which were proposed for use in the generator units. The outline design of metering equipment and the inevitable stray losses which could be expected in the analyser network indicated that it would be imprudent to use a base current of less than 5 mA. After consideration of the many conflicting factors involved, the following compromise base values were adopted:

Voltage	50 V	Power	250 mVA
Current	5 mA	Admittance	100 micromhos
Impedance	10 kilohms ($C = 0{\cdot}318\,\mu F$)	Frequency	50 c/s

Subsequent developments have indicated that the power base of 250 mVA could be further reduced now that transformer core material having improved loss characteristics is available. Against this, however, it must be remembered that the residual output of the amplifiers associated with the metering system is predominantly of mains frequency, and a reduction in power and current base would necessitate a more stringent specification for these amplifiers. Operational experience with the numerous analysers already in operation has indicated that no radical change in base operating quantities is either necessary or desirable.

The equipment is ordinarily constructed from basic standard units and is completely universal in its application to system problems. It can, however, be used in conjunction with a geographical network layout if desired without adding complex and consequently expensive ancillary equipment. There has, however, as yet been no requirement for the development of such a feature. This doubtless follows from the ease with which the analyser can be operated when used as a completely universal equipment.

General Description of Equipment

The arrangement and extent of a typical medium-sized installation is shown in Fig. 10. This indicates the disposition of standard units which is generally adopted for most equipments. Essentially, each analyser consists of a central common equipment rack comprising mains power supply equipment, mains voltage stabilisers, main metering equipment and impedance calibration equipment, adjacent to which are located the various functional units of the analyser, i.e., interconnection panel assemblies, generator units, load impedance units, auto-transformer units and shunt-susceptance units.

The facilities and ranges afforded by these units are shown in Table 3.

Generator Units

Generator units provide sources of e.m.f. for exciting the analyser network and are independently variable in respect of both phase and voltage. They comprise a Magslip transmitter/variable-ratio transformer combination. The former are supplied direct from a 3-phase 50 V 50 c/s stabilised supply system. Output voltage of the unit is monitored by a voltmeter calibrated 0—1·5 per unit volts and fitted with a red index pointer. The Magslip rotor assembly is driven via a slow-motion dial having drive ratios of 50:1 and 1:1, respectively. Being fitted with a vernier scale, it permits an angular resolution of 0·1° to be obtained. The output impedance of a unit when adjusted for 1·00 per unit terminal voltage is approximately $0{\cdot}007 + j0{\cdot}002$ per unit.

Load-impedance Units

Load-impedance units, which are used for the representation of real and reactive (lagging) loads, consist of switched parallel branches of resistance and capacitance, all of which are supplied from the secondary of a variable ratio auto-transformer. Details of the ranges are contained in Table 3. All resistance and capacitance ranges have their setting positions identifiable, thus permitting the speedy calibration of the units by reference to calibration charts. The setting of a particular unit can be recorded in those cases where the possibility of repetitive studies exists.

Line-impedance Units

These units comprise ranges of series connected variable resistance and capacitance. The normal operational impedance range is as shown in Table 3, but owing to the inverse relationship between capacitance and reactance the upper reactance setting is in practice well in excess of

* Kimbark, E. W., Starr, J. H., and Van Ness, J. E.: "A Compact, Inexpensive, A.C. Network Analyser," *Transactions of the American IEE*, 1952, 71, Part 1, p. 122.

1·00 p.u. and limited only by considerations of calibration and resolution. The lowest reactance setting—which is related to the total value of capacitance obtainable—is determined largely by economic considerations. The lowest setting ordinarily employed in standard units is about 0·03 per unit, which corresponds to a total capacitance of about 10 μF, though such a unit can be readily modified for a minimum setting of 0·015 per unit. All resistor and capacitor components used in these units, with the exception of the potentiometers, are of $\pm 10\%$ tolerance, the capacitors being of the tubular paper type. The complement of capacitors for an individual unit is as follows:

Range I:	$9 \times 1{\cdot}000\ \mu F = 9{\cdot}000\ \mu F$
Range II:	$9 \times 0{\cdot}100\ \mu F = 0{\cdot}900\ \mu F$
Range III:	$9 \times 0{\cdot}010\ \mu F = 0{\cdot}090\ \mu F$
Range IV:	$5 \times 0{\cdot}002\ \mu F = 0{\cdot}010\ \mu F$
Total ..	$10{\cdot}000\ \mu F$

The representation of various transmission line equivalent circuits is achieved by using the standard line impedance units in association with shunt-susceptance units (see below), the necessary connections and metering arrangements being effected on the interconnection panels. Several preferred methods of interconnection have been suggested and, in fact, used.

Since all switch-positions on the units are identifiable, a close approximation to the desired calibration can be made by reference to a typical calibration chart.

Auto-transformer Units

These consist essentially of an auto-transformer together with associated ratio-change switching facilities. When it is desired to represent the series impedance of a transformer, a unit is used in association with a line-impedance unit. The winding arrangement employed gives a voltage deviation of $\pm 0{\cdot}20$ per unit voltage in 0·01 unit increments. This is achieved by having three main sections of winding, i.e., one 1·0 per unit section, one $4 \times 0{\cdot}04$ per unit section and one $4 \times 0{\cdot}01$ per unit section, the ratio adjustment being effected by variation in tap selection and winding sense of each sectionalised winding.

Mumetal is used as core material, the typical total loss when supplying nominal full load (i.e., 250 mVA at unity power factor from the high-voltage winding with a ratio of 1:1·20) being approximately 0·015 per unit. Approximately 0·0015 per unit of this is attributable to winding copper loss. The magnetising component of the no-load admittance is compensated, at unity ratio, by the inclusion of a 4,500 pF capacitor in parallel with the main 1·0 per unit voltage winding. The equivalent leakage impedance of the transformers is $0{\cdot}0017 + j0{\cdot}00046$ per unit impedance and $0{\cdot}0035 + j0{\cdot}0009$ per unit impedance for the maximum boost and buck conditions, respectively.

Shunt-susceptance Units

Owing to the practical and economic difficulties associated with the manufacture of a near-pure inductance for this application, the alternative of a parallel LC circuit is used. In this instance the inductance has one tapping, thus providing two values of inductance, 430 Henrys and 172 Henrys, respectively. The associated capacitance range is provided by banks of switched moulded mica-type capacitors which are selected by 18-position switches. The total capacitance range is nominally from zero to 39,600 nF, thus giving an overall range of susceptance for the parallel combination of 0·03—0·19 per unit. The inductance is wound on a Ferroxcube core and has a Q-factor of approximately 25 as determined by bridge measurement. The normal operating range on this basis is in the region Q=25 to 8, the latter being considered the minimum value consistent with adequate accuracy of representation. Variations in nominal setting with changes in line-to-neutral voltage do not exceed approximately 0·08% in the voltage range 0—1·2 per unit. The range of susceptance can be varied as also can the Q-value by suitable selection of L and C values and by modification of the inductance design. As far as the Q-values are concerned, the matter is essentially one of compromise between desired Q-value and cost.

Table 3. Standard Functional Unit Ranges

Type of Unit	Ranges
Generator ...	Output Voltage – 0 –1·50 p.u. Phase – – – – 0 –360° Power output – 0 –10·0 p.u.
Load Impedance ...	Real Power – – 0 –2·00 p.u. } at 1·0 p.u. Reactive Power – 0 –1·20 p.u. } voltage Auto-transformer Ratio 1:0·80–1·20 (in 0·01 steps)
Line Impedance ...	Resistance – – 0·00–0·56 p.u. Reactance – – 0·03–1·00 p.u.
Auto-Transformer	Voltage Ratio –1 : 0·80–1·20 (in 0·01 steps) Series impedance–As for line impedance unit
Shunt Susceptance	Susceptance – –0·03–0·19 p.u. (at 1·0 p.u. voltage)

Main Metering Equipment

A functional schematic of the main metering system is shown in Fig. 12. It performs the dual functions of network impedance calibration and measurement in the analyser network, the former when used in association with the impedance calibration equipment. As will be seen from the diagram, it consists essentially of two separate amplifier channels, one each for the current and voltage circuits, respectively, together with associated stabilised power-supply units and a single indicating instrument. The facilities provided enable the following quantities to be measured:

Voltage
Current
Real power
Reactive power
Relative voltage phase angles } In conjunction with variable-phase
Relative current phase angles } impedance calibration source.
Resistance
Reactance
Conductance } In conjunction with variable-output-voltage impedance calibration source.
Susceptance

The range of voltage and current measurement provided are shown in Table 4.

The design of the amplifier channels follows conventional practice, negative feedback of both the voltage and current types being employed. The current channel comprises a two-stage pre-amplifier having overall negative voltage feedback and a two-stage output amplifier having

Table 4. Voltage and Current Ranges

Quantity	Range	Per unit value for f.s.d.	Scale Multiplier	Actual reading for f.s.d. Volts	mA
Voltage ...	1	0·250	0·20	12·50	—
	2	0·625	0·50	31·25	—
	3	1·250	1·00	62·50	—
	4	2·500	2·00	125·00	—
Current ...	1	0·250	0·20	—	1·250
	2	0·625	0·50	—	3·125
	3	1·250	1·00	—	6·250
	4	2·500	2·00	—	12·500
	5	6·250	5·00	—	31·250

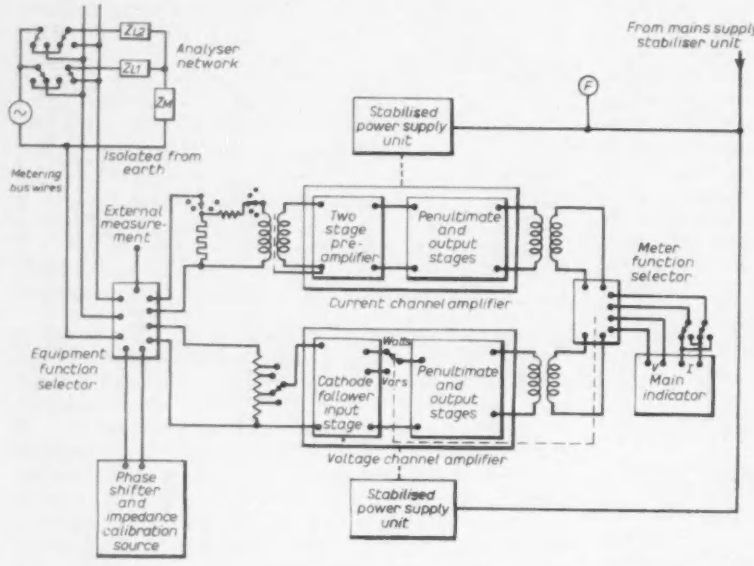


Fig. 12. Schematic diagram of functional lay-out for metering system of a 50 c/s a.c. network analyser

overall negative current feedback. The input stage of the pre-amplifier derives its input via a unity ratio transformer from the voltage drop produced across a precision shunt which is inserted in the analyser network at the selected point of measurement. The insertion effect of the shunt is negligibly small, being equivalent to an additional 0·001 per unit impedance connected in series with the network. The input transformer, which has a negligible shunting effect on the shunt, is both electrostatically and electromagnetically screened. Changes in current range are effected by the selection of differing values of shunt, a voltage drop of 12·5 mV r.m.s. corresponding to full-scale deflection on the main instrument (100 mA r.m.s.). The primary circuit of the input transformer forms a bridge network which enables an approximate balance of the primary-secondary capacitance currents in the primary winding to be obtained. This ensures that the primary-secondary capacitance current does not contribute effectively to the output of the channel. The negative current feedback applied over the output amplifier stages gives an output impedance of approximately 900 kilohms, and when the channel is delivering maximum rated output the total harmonic distortion introduced by the channel is not greater than 1·0%, while the total hum and noise level is not greater than 0·1% of the current corresponding to full-scale deflection, i.e., 100 mA r.m.s. The linearity between input and output is within 0·2% of the output for full-scale deflection in the range 50% to 100% output current.

The voltage-channel amplifier derives its input from a resistance voltage-divider network connected between the line and neutral of the analyser network. The insertion effect of the divider is again negligibly small and at 1·0 per unit voltage corresponds to a current drain of 0·002 per unit. The input voltage for maximum output current (100 mA r.m.s.) is 12·5 V r.m.s. The input is fed to a cathode-follower stage from which two alternative outputs differing in phase by 90° are available, selection being dependent upon whether it is desired to measure real or reactive power. The output and penultimate stages of the voltage-amplifier are identical in all respects to those of the current amplifier channel, and the performance of the channel in respect of linearity, hum and noise level, etc., is equal to or better than that of the current channel. The connection of the main indicating instrument to the two amplifier channels is performed automatically by a function-selector switch which determines the quantity being measured, i.e., voltage, current, real or reactive power.

The use of negative current feedback in the output stages, with a consequential high output impedance, minimises the errors in measurement introduced by the finite value of mutual inductance which exists between the fixed and moving systems of the main dynamometer indicator and also obviates the necessity for using high stability close-tolerance components in the load-impedance circuits of each channel. The operating current for full-scale deflection of 100 mA r.m.s. gives a reasonable compromise between considerations of economic output-stage design and an adequate torque/weight ratio for the moving system of the dynamometer indicator.

Each amplifier channel is supplied from a separate stabilised power-supply unit of conventional design, thus minimising any possible interaction between the two channels by virtue of a common supply-source impedance. Valve monitoring facilities are incorporated in the unit, as also is a mains-frequency meter, so that a continuous indication of operating conditions is available. Ordinarily, frequency deviations in excess of ±0·2 c/s rarely obtain.

The performance of the metering equipment when measuring real or reactive power is affected to some extent by variations in mains-frequency. However, with a ±0·2 c/s frequency deviation the changes in real power indication are insignificantly small, whilst the reactive power indications are within ±0·25% of nominal.

Calibration of Main Metering Equipment

The metering equipment is designed so that its calibration may be undertaken in a meter laboratory appropriately equipped to meet the requirements commonly encountered in the electricity supply industry. The main indicator calibration can be determined with a d.c. potentiometer and thereafter it can be used as a d.c./a.c. transfer instrument. All that is required in addition to this verification is the availability of a precision-grade voltmeter having known correction factors, and a range of precision-grade resistive and capacitive load-impedance units. With these facilities and adherence to a standard sequential procedure for calibration the equipment will give a consistent high accuracy performance over long periods of time.

Impedance-calibration Feature

Since the shunt and series impedance elements of the analyser network are uncalibrated, provision has to be made for their individual calibration as circumstances demand. Ordinarily, the shunt elements are calibrated with 1·0 unit voltage across their terminals whilst the series elements are calibrated with a 1·0 per unit current flowing through them. The measurement and correlation of real and reactive power dissipation in the network elements

then gives, to some scale, the actual resistive and reactive impedance, respectively, of the network elements. The impedance calibration source is a Magslip transmitter unit of the same type as used in the generator units. When used for impedance calibration its three-phase stator winding is energised on two phases only and with rotation its rotor circuit thus constitutes a source of variable e.m.f. The measurement of real and reactive power is carried out by the main metering equipment, which is used in association with the impedance calibration unit. Separate instruments are provided for the measurement of voltage across shunt elements and current through series elements whilst being calibrated so as to avoid unnecessarily frequent selection of meter function. Incorporated in this unit is a master selector switch which determines the function of the main metering equipment. The six facilities available are as follows:

(a) Shunt-impedance calibration	Using variable-voltage constant-phase impedance-calibration source.
(b) Series-impedance calibration	
(c) Network measurement.	
(d) Relative voltage phase-angles	Using variable-phase constant-voltage impedance-calibration source.
(e) Relative current phase-angles	
(f) External measurement.	

It will be noted that (f) above enables the metering equipment to be used in an isolated condition, thus providing a useful self-contained precision metering equipment for laboratory use.

The chief use of the impedance calibration equipment is for the final trimming of unit calibrations before putting them into operational use. An extensive range of typical calibration charts covering all types of unit is provided. The use of these charts reduces significantly the time required for calibration.

Power Supplies

The three-phase 50 c/s mains supplies are fed to three star-connected voltage stabiliser units which ensure that the variations in mains supply voltage are reduced to an acceptable level, thus permitting the continuous operation of the analyser. In order to minimise the effects of harmonics already present in the supply, a regulator of the servo-operated variable-ratio booster transformer type is employed. The r.m.s. output available is stabilised to within ±0·25% under the following operating conditions:

Input voltage	−17·5 to +8·75%
Load Current	0—9 A
Load power factor ..	0—1 (lagging or leading)
Frequency	45—65 c/s
Temperature variation	From normal ambient up to 20°C.

The speed of response of the regulators for small voltage deviations, e.g., ±3 V is equivalent to about 12·5 cycles of the supply frequency, whilst for deviations in excess of this a response of 0·15 V/sec is achieved.

CONTRACTORS ASSOCIATED WITH THE 50 c/s A.C. NETWORK ANALYSER PROJECT

A list of the principal contractors associated with these equipments is given below:

Nash & Thompson Ltd.	Functional unit manufacture and overall installation.
Alfred Imhof Ltd. ...	Rack and chassis assemblies.
Salford Electrical Instruments Ltd. ...	Panel instruments for generator and load units.
Sangamo Weston Ltd.	Main indicator and impedance calibration instruments.
Servomex Controls Ltd.	Mains voltage stabilisers.

A separate unit provides 3-phase 3-wire 50 c/s 50 V supplies for the generator and impedance calibration unit Magslip transmitters. It consists of three single-phase transformers, each of 150 VA rating, with both primary and secondary windings connected in star, this rating being adequate for ten generator units and one impedance calibration unit. Mains isolating equipment and protective fuses are also incorporated.

Termination and Interconnection Fields

The various functional elements of the analyser are mounted in enclosed racks, each of which contains a termination and interconnection field assembly situated in a standard position. The fields normally:

(a) Serve as a central termination field for the functional units within a rack.

(b) Accommodate the circuit selector switches used to insert the main metering equipment in the functional units within the rack.

(c) Enable functional units to be assembled to represent a network which it is desired to study.

(d) Permit direct connection to the impedance calibration equipment located in the common equipment rack and the main analyser neutral busbar.

The rear of each field is used for carrying the various supply bus wires, etc., throughout the length of the equipment. By this means, rearrangement of an existing analyser or its future extension can be effected without recourse to major internal modification.

Operational Performance of Equipment

In order to gauge the performance of the analyser, a range of typical power system problems was solved, each having a known solution. It is sufficient to indicate that the bulk of the measured data was within ±1% of the calculated values, whilst all were within ±2% of the calculated values.

It was known, however, that inevitable minor physical imperfections in the analyser network contributed in varying degrees to the errors obtained. The most important contributory factors in this respect are:

(a) The presence of stray line-to-neutral capacitance in the line-impedance units.

(b) The finite, though small, residual output of the current channel amplifier.

(c) Slight unbalance of the input bridge network of the current-channel amplifier.

(d) The inevitable fact that the main metering equipment does not possess nominal zero error under some or all conditions of measurement.

A considerable fund of operating experience with the many equipments now in service has been accumulated and the adequacy, reliability and performance of the equipments have amply justified the choice and design of analyser equipment. Doubtless, the application of the analyser will be extended with the passage of time by the introduction of additional functional units, and there is every indication that the number of equipments will continue to increase as their potentialities become more widely known and exploited.

Acknowledgments

The author wishes to thank the Chief Transmission Engineer of the Central Electricity Generating Board for permission to publish this series of articles and to use the information on which it is based. He also wishes to thank the Chief Engineer of the Eastern Electricity Board for permission to use the Board's equipment for illustration purposes.

Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Heating in Canada

RESISTANCE heating for homes is quite rare in North America. Your readers may be interested in results obtained here in Victoria, Canada. The installation covers a bungalow of 1,350 sq ft, 10,000 cu ft space with seven rooms. Each room has its individual heater and thermostat control. The heaters are convector type, baseboard mounting and are 7 in. high by 3 in. deep, and vary in length from 4 ft to 10 ft, according to the loading of 1 kW to 2·75 kW.

Victoria is in the same latitude as Paris, but has a mild, cool climate similar to that of Northern Ireland. Some heating is required for 11 months out of the 12.

Except in the bedrooms, which are left cool, the thermostats are set at between 70° and 75° F. This is a little low even for the coastal area, and very low compared with other parts of America where the room temperatures are commonly maintained at between 80° and 85° F.

Hot water is from a 2 kW immersion unit, and there is the usual range, refrigerator, etc. The room heaters total 13·75 kW.

During the past year, the maximum demand was 11 kW; kWh consumed 24,500; cost $399·71; cost per kWh 1·63 cents.

The rate schedule is too complicated to explain in this letter, but is based on a penalising rate for the six colder months, so that a certain number of kWh/kW of demand are paid for at a higher rate. The result is that the monthly kWh rate has varied between 1·59 and 1·90 cents per kWh.

The above cost is probably about $70·00 a year higher than a combination of electricity for domestic purposes and oil space heating. Oil heating leaves a tarry deposit in the chimney which has to be cleaned out periodically, and a certain amount eventually gets into the house as well, so perhaps all told there is little in ultimate cost.

J. P. Thornton,
VICTORIA B.C., CANADA.

Generation by Free-piston Engines

IN the article "Generation by free-piston engines" on page 843 of the ELECTRICAL TIMES, 1 December, it is stated that free-piston engines manufactured by the National Gas and Oil Company are in use for electrical generation in installations ranging from a single 6,000 kW unit to a power station producing 36 MW. This is a serious error of fact. The only 36 MW free-piston power station in the world, in use at present, is at St. James Power Station, Singapore. There are no gasifyers or free-piston engines manufactured by the National Gas and Oil Engine Co. in this station. All gasifyers or free-piston engines for this station were provided by ourselves, the Free Piston Engine Co. Ltd., of Feltham, Middlesex, and manufactured by our parent group, Associated British Engineering Limited.

We are the main contractors for this 36 MW power station at Singapore which was officially opened on 2 July, 1960.

W. G. Fryer, C.B., C.B.E., M.I.E.E.,
SALES DIRECTOR,
FREE PISTON ENGINE COMPANY LTD.,
FELTHAM, MIDDX.

Lights on Motorways

I WAS most interested in the article which appeared on page 931 of last week's ELECTRICAL TIMES dealing with the motorways. I travel on the M.1 a good deal and, with regard to night driving, there is of course the hazard which is mentioned in wet weather, but on a dry night I think a lot of confusion is caused by shadows which are thrown on the stark white reinforced concrete bridgework, and I would strongly recommend that these structures should be spray painted with some green compound to cut out shadow troubles.

I quite agree with the remarks made regarding signal lights, and it is quite noticeable how many large lorries are not properly fitted with any clear means for showing what direction they are taking. In some cases lorry drivers give hand signals which cannot be seen in the dark and, more particularly, at high speed. I frequently have seen three lorries in line, one occupying each lane when passing. This should be forbidden.

W. G. Picton,
LONDON, E.C.1.

E.C.C. Size

I HAVE been approached by a private contracting electrician to give guidance on the following problem: In a recently completed installation the six 7/·029 earth continuity conductors from six separate t.r.s. flat twin and earth 7/·036 cables, were connected for convenience to an adequately rated brass block. He continued his earth circuit with a 7/·052 conductor; after consulting table 4 of the current edition of the Institution for Electrical Engineers regulations for the electrical equipment of buildings.

He became concerned when a supply authority's workman completed the e.c.c. to the supply authority's earth terminal with a short length of 7/·029.

Uneconomical—or unsafe?

Chartered Electrical Engineer.

ARC FURNACE PROBLEMS

IN the discussion on the IEE paper on arc furnaces (page 923, ELECTRICAL TIMES, 15 December), Mr J. R. Phillips (English Steel Corporation) stressed the problem large furnaces presented to supply engineers, because the power input to a furnace varied from cycle to cycle, causing a flicker on the voltage of the whole supply system. Mr H. J. Sheppard (YEB) said that for the largest furnaces, it was necessary to provide direct connection to the 132 or 275 kV system in order to obtain a system impedance low enough to reduce voltage fluctuation below noticeable level.

Mr P. R. Harrison (Birlec-Efco) suggested that of the methods discussed by the author, only the equivalent circuit was of any use, due to considerable variation of the reactance characteristic during the breaking down stage, when the electrode arms were not in an in-line position. Changes could amount to 20% of the reactance. Mr W. J. Kelsey (Metalectric) thought it would be impossible to meet supply industry requirements about voltage flicker without resorting to expensive buffer reactors and synchronous condensers. Mr W. L. Harrison (GWB) said average working power factor was affected by furnace construction and type of electrode regulator.

Cables under short-circuit stress

E.R.A. SHOW LIMITING FACTOR IS MECHANICAL DAMAGE

THERMAL damage to the joints or the sheath and the possibility of bursting under electromagnetic forces are the three vital factors which limit the short-circuit currents that lead-sheathed, paper-insulated cables will carry with safety under short-circuit conditions.

These important conclusions summarise results of the first stage of an extensive research programme undertaken by ERA, which was described to the IEE last week.* How these conclusions will affect the practical design of cable systems formed the subject of a second paper.†

It has long been recognised that the short-circuit recommendations put forward in 1937, which included the requirement that cable temperature should not exceed 120°C, were conservative, especially since Sweden, the USA and certain European countries permit a maximum conductor temperature of 200°C. The papers describe the first stage of a research programme which will eventually cover most types of cable, including those with aluminium and plastics components. In this first stage the cables investigated were single-core and belted multicore types, with copper conductors and lead or lead-alloy sheaths, suitable for voltages up to 11 kV.

Factors Considered

Heating produced by the passage of the short-circuit current has a direct effect on the conductor, dielectric and sheath. However, it also produces important mechanical effects indirectly, as a result of thermal expansion. Direct mechanical effects are also produced by electromagnetic forces, which tend to burst the cable. The behaviour of a cable will also be strongly influenced by repeated short-circuits which may result from the use of auto-reclosers. The authors do not deal directly with this aspect in the paper but consider it best dealt with separately, after a basis for short-circuit ratings has been agreed. Several secondary factors affect the cable behaviour but these were found to have little significance. The paper is based on short-circuit durations not exceeding 3 sec. This is the maximum time normally allowed by the CEGB for area boards to disconnect a faulty network.

Although conductor maximum temperature was shown to be less of a limiting feature than other factors, to prevent insulation charring the peak conductor temperature should not exceed 270°C. It could be rather more for small, rapidly cooled conductors, or rather less for large, slower-cooling conductors. For drained or aged and dry cables, the assumption that all heat is retained was experimentally justified so that heat losses should be neglected in assessing peak temperature. However, for new, well-impregnated cables, energy losses up to 20% at 300°C were found on some samples.

The maximum sheath temperature must be restricted to between 200°C and 250°C, for above this temperature range serious damage may be caused by fracture due to thermal expansion and possibly by changes in the sheath material structure. Both circumferential and longitudinal fractures of the sheath occurred on test lengths of cable, above 260°C. The circumferential fractures are attributed to longitudinal restraint imposed on the sheath by the core, while the longitudinal cracks are possibly caused by electromagnetic hoop stress between conductor and sheath.

In contrast with the conductor tests, the maximum temperature in the sheath was found to be significantly less than that calculated by neglecting heat losses. For different sizes of cable in air, the temperature reduction varied from 10% to as high at 25% and nearly doubled if the cable was embedded in compound. For wire-armoured cable, the paper recommends basing temperature rise on total energy absorption, allowing for current division between sheath and armour as deduced from their relative resistances at 20°C. On this basis, the heat losses from the cable provide a temperature safety margin of at least 10%. This recommendation is subject to two important qualifications; for the purposes of temperature rise calculation, tape armouring should be ignored, and account should be taken of reduction of cross-section due to corrosion for steel-wire armoured cables.

Mechanical Forces

Fault currents which are quickly interrupted, say in 0·2 sec, may cause insufficient heating to damage the cable thermally, yet the resulting electromagnetic forces may

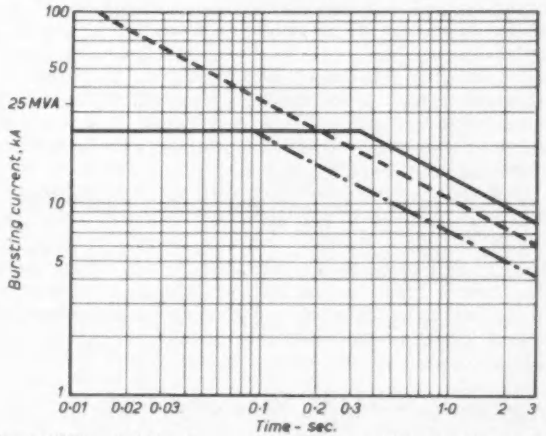


Fig. 1. 1938 and 1960 recommendations compared for the safe current carrying capacity of four-core 0·2 sq in. p.i.l.c.s.t.a., 1,100 V cable under short-circuit conditions:
1938 based on 120°C conductor temperature: — — — — — — —
1960 based on 160°C conductor temperature and bursting current limitations: ———
1960 based on 250°C sheath temperature: — . — . — . — . —

* Paper No. 3314: "A Basis for Short-Circuit Ratings for Paper-Insulated Cables up to 11 kV," by L. Gosland, B.SC., M.I.E.E., and R. G. Parr, B.SC.(ENG.), A.M.I.E.E., both of ERA.

† Paper No. 3284: "Short-Circuit Ratings for Mains Cables," by G. S. Buckingham, B.SC.(ENG.), M.I.E.E. Mr Buckingham is chief engineer, MEB.

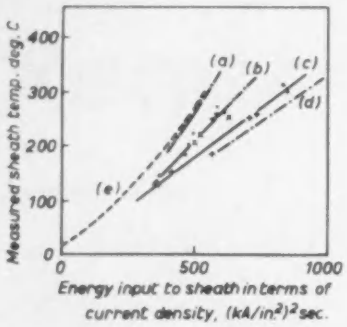


Fig. 2. Heat losses from sheaths in air. Variations in tightness of sheath on core probably accounts for differences. (a) 0·0225 sq in., 1-core; (b) 0·15 sq in., 1-core; (c) 0·15 sq in., 3-core; (d) 0·15 sq in., 1-core; (e) theoretical, no heat loss

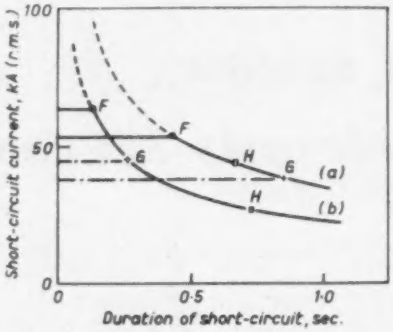


Fig. 3. Bursting limitation on short-circuit current: (a) 0·5 sq in., 1,100 V; (b) 0·3 sq in., 11 kV. F represents theoretical bursting current; G represents suggested limit to avoid bursting; H represents maximum current of standard o.c.b.

burst the sheath and belting. This condition applies only to cables with large conductor cross-section and will not apply to cables protected by h.r.c. fuses.

Cable joints in multicore cables are vulnerable to another side-effect of heating. Thermal expansion of the cable may cause the joints to yield in compression. Higher voltage joints proved more consistent than low-voltage joints in the tests conducted by ERA, probably because of the spacers incorporated in them. With porcelain spacers, 11 kV cables were found to be about 30% weaker than those with pre-impregnated paper spacers. The authors suggest minor changes in practice could ensure that joints at all voltages up to 11 kV could be constructed to have the recommended minimum strength of 8,000 lb/sq in. of total conductor cross-section.

Safety Criteria

From their experimental results, the authors conclude that sheath currents are decisive for all cables except very small unarmoured multicore cables, s.w.a. three-core 11 kV cables up to 0·3 sq in. and s.w.a. four-core 1,100 V cables up to 0·5 sq in. If the fault lasts for 0·2 sec or less, bursting currents are decisive for 0·3 sq in. and larger 11 kV cables and for 0·2 sq in. and larger 1,100 V cables. These limits can be waived with h.r.c. fuse protection.

Consideration of mechanical stress due to thermal expansion indicates that conductors of 11 kV multicore cables should not be allowed to exceed 120°C above a temperature at the mean of the normal operating range and known as the stress-free temperature. For 1,100 V cables the figure is 100°C. Recommendations for actual cables sizes are given in the first paper. Under short-circuit conditions, the sheath temperature, with heat losses neglected, should not be allowed to reach 250°C.

Provided the three-phase fault current is equal in magnitude and duration to the earth fault current, either the sheath or the conductor current limitations may be decisive, depending on the cable construction. In all cases, the limit is based on mechanical damage to sheath or joints. Insulation charring and melting of solder do not impose more severe limitations on short-circuit current ratings.

Application to H.V. Networks

Curves based on the ERA recommendations for various cable sizes are given in Mr Buckingham's paper. He points out that modern joints are better able to withstand buckling than older designs and for the older types safe currents should be reduced by 10%. In this context, end dividing boxes are regarded as joints.

A single-core construction must be used for p.i.l.c. cables linking grid transformers to 11 kV or 6·6 kV switchboards because of the heavy load currents involved.

Phase-to-phase faults are unlikely to develop on such a cable run and, if they occur in any other part of the system, provided the switchgear clears the system within 3 sec no damage would result to the cables. However, an earth fault to the sheath could damage the sheath. But provided the normal practice of earthing the system neutral through a resistor limiting the current to 2 kA is adopted, no further special precautions are necessary.

For three-core 6·6 kV or 11 kV feeder cables the wire armouring relieves the lead sheath from the full fault return current and the conductor temperature becomes the limiting factor. The efficacy of the armouring may, however, be affected by corrosion, especially in bad soil, and it may then be better to regard the cable as lead-sheathed only. If the sheath is not in good condition, or if tape armouring is used, sheath temperature again becomes the limiting condition under double earth fault conditions and even 0·5 sq in. cable is safe for only 1·3 sec. For this reason, single-wire armoured cables are advised where the short-circuit level is high.

In connection with high-speed interruption of circuits, although cables can be disconnected in less than 0·2 sec it is considered better practice to regard this as the minimum time, to allow for back-up protection to come into operation in the event of failure of the high-speed protection.

Distribution Substation for H.V. Networks

If a 33 kV distribution system is used from the grid substation for transformation to 11 kV and it is assumed that the system reactance limits the fault level to 150 MVA, then a three-core 0·2 sq in. p.l.y.s.w.s. 11 kV feeder cable is safe for 3 sec and a similar 0·1 sq in. cable for 1 sec.

The new ERA recommendations are more onerous and indicate the need for system design to meet short-circuit conditions. Larger conductors may be necessary than have been used in the past, and single core cables may need to be more widely applied to limit phase-to-phase faults. Perhaps the use of screened cables should be encouraged.

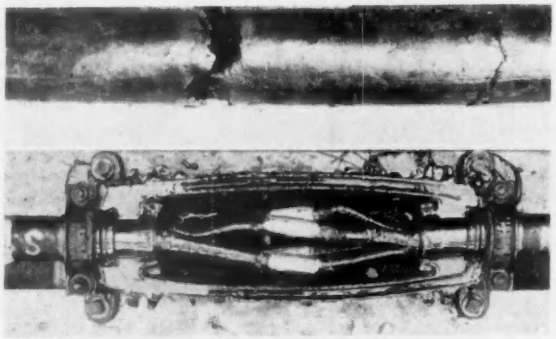


Fig. 4. The top picture shows longitudinal and circumferential fractures caused by thermal expansion. Below is illustrated joint damage due to compressive forces in an 1,100 V four-core cable box

L.V. Networks

The findings show that l.v. networks cannot be adequately protected by devices taking 3 seconds to operate, and h.r.c. fuse back-up protection is essential. Even a 100 kVA, 433 V transformer would need a single core 0·6 sq in. cable on the l.v side to be safe for a 3 second fault duration.

On large solidly interconnected l.v. networks fed from a number of medium-size transformers, the faults would generally take the form of high resistance earth faults and temperature limits would not be exceeded. The value of such networks would in general outweigh damage which would result from the relatively infrequent occurrence of more serious faults.

Underground service cables are perhaps the greatest risk. A 600A fuse would give adequate protection to a twin 0·0225 sq in. p.l.y.st.s cable solidly connected to a 4 core 0·3 sq in. main with a 25 MVA short-circuit level, near a substation. But, at a distance of 500 yards, the length of the fuse blowing time would permit serious damage to any cable smaller than 0·06 sq in. Such a fuse rating must be matched with load conditions and due allowance be made for load growth. The new recommendations are unlikely to affect sizes of l.v. distribution mains.

Most of the recommendations, particularly the use of h.r.c. back-up fuses, apply to industrial installations. In power stations, it is the practice to use a minimum of 0·2 sq in. 3-core cables for connections to 3·3 kV 150 MVA switchboards. These cables would withstand the short-circuit rating for 0·3 seconds, but it is important to ensure that terminating boxes on equipment are large enough for this size of cable and the short-circuit conditions. Otherwise, breakdowns in terminal boxes may increase.

DISCUSSION

MR L. H. WELCH (LEB) said the authors had made out a good case for the use of armoured cables and confirmed his opinion that, in certain respects, tape armouring was not much use. However, the paper indicated wire armouring was more economic than a plain lead sheath. He thought Mr Buckingham's tables and comments should be made available to every distribution engineer. The screened cable had many advantages, its only disadvantage was price. He said he would like to see more standardisation of low voltage jointing techniques and he thought they probably required more care than 11 kV joints. The three-second duty was rather onerous and probably only occurred on 11 kV systems when busbar faults were not cleared by protection gear.

MR P. M. HOLLINGSWORTH (BICC) said that little was known about cable short-circuit behaviour before the ERA investigations. Although cables had operated satisfactorily for a half a century without this knowledge they may not continue to do so in the future. He asked how it was that the Europeans got away with 200°C rise when the paper recommended only 160°C. Could it be the result of more rapid fault clearance? The behaviour of the lead sheath under short-circuit rating was the most important limiting factor for unarmoured cables. If the lead sheath thickness were reduced to line up with Continental standards the situation would become worse. Clearly there was a need to study the economics of short-circuit ratings. The recently introduced corrugated aluminium sheath with a thickness of only 1/64 in. had ratings between 1¼ and 2½ times that of a lead sheath.

MR R. S. ORCHARD (Merz and McLellan) said the decision would now be necessary whether to apply the 160°C criterion for pressure and solid cables at higher voltages and whether it would be satisfactory practice. The effect of oil ducts and reinforcement in gas pressure cables may make this temperature restriction rather conservative. He commented on the wide time range used in the papers from 0·2 sec to 3 sec. If times could be standardised for various applications it would be possible to use a simple table. He suggested allowing 1 sec for circuit-breaker operation by discriminating type of relays and, perhaps, 0·5 sec for power station instantaneous protection and for h.r.c. fuse protected cables, 0·2 sec. Mr Buckingham's paper was based on 3·3 kV and 400 V systems with resistance earthing. However, this was not the general practice on many systems. For these circuits, earth fault indication would be most valuable.

MR C. C. BARNES (CEGB) said that some of the recommendations in the paper implied much larger cables sizes than are now used for certain applications. In his experience there were few concrete cases of cable short-circuits. The papers, unfortunately, only applied to a very limited range of cables and investigation was urgently required of thermoplastics and pressure-assisted cables for all voltages.

MR D. E. BIRD (Ewbank and Partners) commented that plain lead-covered cables should be avoided where possible. If an earth fault was outside the cable run, fault current would be shared by the three cables. He asked if, on circuits with auto-reclose, the authors could give some idea of a factor to apply for different intervals of time.

MR D. T. HOLLINGSWORTH (BICC) suggested that the cables tested were not specifically designed for the short-circuit ratings used. It would be possible, at extra cost, to increase the robustness of cables, for example, by increasing the hardness of the lead sheath and armour.

MR A. G. THOMAS (Alcan) gave some comparative figures for aluminium sheathed cables.

MR MIRANDA (Pirelli-General) speaking on behalf of Mr Morello, commented on temperature limitations for lead-sheath cables. He thought 160°C a better sheath temperature than the 200°C recommended by the authors, while for short-circuit forces he thought currents about half the value suggested by the authors should be used. 200°C was not safe enough but, perhaps, 160°C was rather too conservative, although it allows for mechanical deterioration caused by ageing of the dielectric.

MR J. SOLOMAN (CEGB) spoke with reference to power station design. The paper referred to use of earthing resistance particularly for greater than 150 MVA ratings, but several installations were operating with cross sections very much less than 0·2 sq in. as recommended in the paper, possibly due to faster clearing times. Referring to h.r.c. fuse back-up protection for o.c.b. and a.c.b's, there were a few installations with medium voltage o.c.b's, the tendency now being to use metalclad air circuit-breakers. Back-up fuses should be used to limit the effect of short-circuits in motor terminal boxes.

MR H. BARNES asked for the authors' opinion on how, after some years' operation, to ensure effectively that fault currents flowed back through the armouring. He suggested p.v.c. sheathing as a necessity to overcome the difficulty of armouring corrosion.

MR C. T. W. SUTTON (Enfield-Standard) expressed himself as being a little worried by the complexity of the new suggestions. ERA had done good work but there seemed to be many complications in applying their findings. Other countries did not see all the complications envisaged in the paper. Would it be possible to increase the rise from 120°C to 160°C with simpler qualifications than those given in the paper?

In reply, Mr Parr confirmed that the findings were applicable to armoured cables. Although as Mr Orchard had suggested, the temperature limits of 250°C and 160°C probably applied to e.h.v. cables, they considered it wise to have experimental evidence before specifying these limits.

In reply, MR BUCKINGHAM said no doubt it was the high quality of cables used in the past that had prevented more serious operation troubles. Aluminium developments for cables were being closely watched, but jointing techniques and anti-corrosion finishes were still not entirely satisfactory. He agreed with Mr Bird that auto-reclosing must be used with care. The MEB used it only in cases where the fault level was fairly low say 35 MVA. It could not be applied to city networks.

PROGRESS IN PATENTS

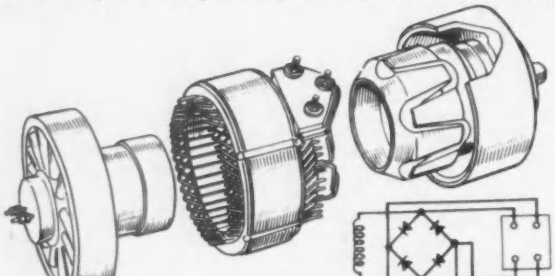
SELECTED SPECIFICATIONS

Brushless Alternator

There is currently a spate of interest in brushless alternators. True, most development is concentrated on smaller output machines for aircraft, automobiles and marine applications but some ideas could easily be applicable to larger generators. Many are based on the use of semiconductor rectifiers incorporated in the rotor with induced a.c. in a subsidiary winding. A different approach is described in Specification 855,551, attributed to General Motors Corp. of Detroit, USA, in which the rotor is a two-pole inductor revolving round a stationary field, the three-phase stator being conventionally placed around the rotor.

The exploded view, reproduced here, shows the exciter field in the form of a cylindrical core magnetised on a horizontal axis by circumscribing windings, the whole being attached to one end-plate. The inductor, a hollow cylindrical assembly of pole pieces supported on non-magnetic annular spacers which, in turn, are attached to the shaft running in bearings on the opposing end-plate, is so arranged that alternate poles are inductively magnetised, north and south, by the field of the stationary cylindrical core. The conventional three-phase stator winding is supported between the end-plates and energised by rotation of the inductor in the usual manner.

Field winding excitation is via rectified current derived from one stator winding through a voltage regulator, shown conventionally as a square in the diagram, supplemented by the compounding winding connected directly

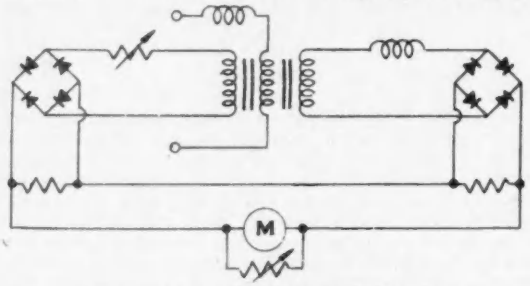


Exploded view of the GMC brushless alternator

across the rectifier. The function of the latter is to relieve the regulator from carrying all of the exciter current.

Frequency Meter

If an impedance is connected in series with an inductor across an a.c. supply, the inductor being designed to reach saturation every half-cycle, it can be shown that the voltage drop across the inductor will, in theory, be independent of supply voltage amplitude but will vary with supply frequency. Such a circuit is, for several reasons, impractical as a frequency-measuring device but, in Specification 855,566, filed by Ferranti Ltd. of Hollinwood, a development of the circuit does, it is claimed, yield accurate measurement of frequency. The inductor is a three-winding transformer, the core material of which has a B-H loop characterised by rapid saturation at flux densities normal to primary excitation. The secondary windings are opposed across rectifier networks, one in series with a high reactance, the other with a variable resistance, the outputs of which are coupled to identical resistances in series with a d.c. moving coil voltmeter. By



Schematic circuit of the Ferranti frequency meter

adjusting the resistance at normal frequency to balance with the inductor, no current will flow in the voltmeter circuit, the null position of which is scaled to read normal frequency. At other frequencies, swings either side of the null position are suitably scaled, while the range of the meter may be adjusted by a further rheostat across the meter movement.

Golf Story

If racing be the sport of kings, golf may be called the sport of presidents. Our American cousins take their game very seriously. They may not, as yet, have applied computer techniques to the analysis of swing but, if patent 855,529, in the name of the Victor Development Co. of New Jersey is anything to go by, they are certainly on their way to doing so.

Briefly, the invention, a golf practice device, comprises a platform on which the golfer stands as he makes his swing at a captive golf ball or "ball simulation" (which, in itself, is enough to make a guttie turn in its grave) standing on a stem before his feet. The platform also incorporates a pattern of photo-electric cells while, over his head, a light is focused downwards. As he makes his stroke the shadow of the club passes over the photo-electric cells, the swing is analysed, together with the force of impact as detected by the "ball simulation," and the result is presented as a pattern of lights on an opaque glass fronted panel "on which a pictorial representation of a golf course or portions thereof may be applied." A coin-operated mechanism controls the number of shies—pardon, "strokes" he can have for a penny. All of this naturally calls for complex electrical circuits with valves, thyratrons and what-have-you which takes no less than 17 pages to describe, with 15 drawings to boot.

The French have a saying, *"chacun a son goût."* For our *goût* we'll take the rolling fairway, sandy bunker and lush velvet green, not a half-cousin to a juke-box or a one-arm bandit.

Reproduced by permission of the Controller of H.M. Stationery Office. Copies of specifications may be obtained from the Patent Office (Sales Branch), 25 Southampton Bldgs, W.C.2. Price 3s 6d.

OVERSEAS NEWS

from our correspondents abroad

CANADA

Power Export Decision Expected

Decisions affecting the long-term plans for exporting Canadian power to the US are expected to be taken shortly by the National Energy Board. The Board are now hearing applications from small licensees for permission to export power. At the present, all power exports are continuing under temporary permits until the Board can complete hearings of individual cases. Applicants for exporting power must have contracts signed with undertakings willing to accept the power in the US and must also show that it is surplus.

Ice Threatens Water Heating

For the first time in 50 years, severe ice conditions on the Winnipeg River have caused the shut-down of three generating stations, at Pine Falls, Great Falls and the McArthur Falls. Although arrangements have been made to import 50 MW from Ontario and a further 50 MW from Saskatchewan, a rationing system may be necessary.

Restoring Supply

A serious fire in August which destroyed most of the main buildings in the business section of Baie Verte also wrecked the power station which was privately owned and operated. At the request of the Government, the Newfoundland Light and Power Co. have taken over the town's system and it is hoped that a new generating unit will be in operation before Christmas.

New Powers for Revelstoke

At a recent ceremony, the Cranberry Creek hydro-electric project, about 15 miles south of Revelstoke, was inaugurated. The project now includes four generators with a capacity of 2 MW.

S. AMERICA

Power Project in the Argentine

An agreement for the construction of a second power station under the El Nihuil hydro-electric project has been signed between Agua y Energia and the Ecovial group. The cost of the project is put at 1,600 million pesos. It is also planned to enlarge the Chivilcoy power station at an estimated cost of 190 million pesos.

New Station for Colombia

It is reported that the Bogota Electric Co. is planning to construct a 33 MW thermal power station near Tocancipa, about 25 miles north of the capital.

Japanese to Study Brazilian Power

Power potential of the River Parana, near Sete Quedas, is to be studied by a Japanese team with a view to constructing a number of power stations utilising falls in the region. The company handling the scheme is the Companhia Hidroelectrica das Sete Quedas, who were responsible for constructing the first section of the Pedreira plant.

U.S.S.R.

Natural Steam Power Project

Following a survey of underground steam generation by volcanic activity, the USSR has decided to construct a power station in the Kamchatka district with two low-pressure turbines rated between 2·5 MW and 3 MW, in the valley of the River Pauzhetka. Boreholes drilled during the exploratory stage yielded up to 150 tons of steam/hr. It is proposed to design larger stations with capacities from 50 MW to 100 MW following the conclusion of geological surveys which will begin in 1962.

Another Volga Hydro Station

Claimed as the world's largest hydro-electric power station, the 2,500 MW hydro-electric plant at Stalingrad on the Volga came into full production recently. Stalingrad is the seventh of ten hydro stations being constructed along the Volga and its tributary, the Kama. The station will enable a unified grid system to be operated west of the Urals. Three other hydro-electric plants on these rivers are nearing completion, each with a capacity exceeding 1,500 MW.

AUSTRALIA

Consultants Recommend Merger

Savings of £50,000 rising to £170,000 by 1965 would be possible by merging the Brisbane City Council and Southern Electricity Authority undertakings, say the British consultants, Merz and McLellan. This recommendation was referred to by Mr Smith, the State Electricity Commissioner, when he presented the annual report. Some of the consultants' recommendations have already been implemented, said Mr Smith, and others were under consideration. He said the Commission were interested in the use of natural gas for power production at Roma and were watching the aluminium development plans with a view to new power stations on the open-cast coal fields in Central Queensland. In the year under review, over £10 million was spent on electrical development and 18,000 new customers were connected.

Aluminium Plant Expansion

A rise in aluminium production at the Aluminium Corporation's Bell Bay Works to 28,500 tons/annum will increase electricity requirements to 67 MW, possibly by 1963. This was stated by the Premier, Mr Reece, in the House of Assembly recently when he gave notice of the Bill to approve the sale of the aluminium undertaking at Bell Bay. A second high voltage transmission line between Trevellyn and Bell Bay would supply the additional power, and survey work for the line is now under way. Expansion would also necessitate new power generation facilities in the future. The Bell Bay expansion forms part of a vast aluminium project in Australia and New Zealand referred to in ELECTRICAL TIMES for 24 Nov., which is being undertaken by the American Kaiser Aluminium Chemical Corporation and the British Consolidated Zinc Corporation. Expenditure in Australia may amount to £125 million in the next six years and, in addition to increasing the Bell Bay smelter capacity to 60,000 tons, plans are in hand for a 360,000 tons/annum aluminium plant and bauxite mine at Weipa in Queensland.

The possibility of aluminium developments at Weipa strengthens the view expressed in some quarters that a large new power station should be built on the Callide coal field.

Aluminium Tanked Transformers

A contract for three 240 MVA, 16·5/348 kV three-phase generator transformers has been awarded to Ferranti. The transformer contract, valued at over £400,000, has been placed by the NSW Electricity Commission for the Vales Point station, about 70 miles north of Sydney. The transformers will have high-speed on-load tap changing gear and, to reduce weight for transportation, they will be enclosed in aluminium tanks.

Personalities *in the industry*

Mr R. W. Dowsett

Mr R. Morgan

Mr A. W. Sinclair

Mr E. R. Acraman

Mr A. H. W. Dell

Deputy general manager of MK Electric Ltd. since January, 1958, **Mr R. W. Dowsett,** ASSOCIATE I.E.E., has been appointed a director of the company as from 2 Jan., 1961. Mr Dowsett joined MK over 36 years ago and has been an executive director since 1944.

Formerly sales manager, **Mr R. Morgan** has joined the board of Morphy-Richards (Cray) Ltd. as home market sales director, and **Mr A. W. Sinclair** has been made a member of the board of Morphy-Richards (Astral) Ltd. with the position of sales director. Mr Morgan started with Morphy-Richards 21 years ago and represented the company in Lancashire, Yorkshire and then London and the Home Counties before being appointed sales manager five years ago. Mr Sinclair joined the Astral Co. in 1950 as sales manager but left them in August, 1959, to take up a similar post for the Electrical Division of Parkinson Cowan Appliances Ltd. He relinquished that position about the middle of this year and was with Merseyside Engineering (Refrigeration) Ltd. for a short period until rejoining Morphy-Richards (Astral) recently.

Members of the Electricity Board for Northern Ireland have been reappointed to continue in office for a further two years. They are: **Mr J. Walker** (chairman), and **Messrs A. G. Algeo, G. Matthews, J. R. W. Murland, A. Shiells** and **W. D. Smyth.**

Mr R. Cox, works manager of Low Moor Fine Steels Ltd., and **Mr B. P. Yates,** F.C.I.S., director of Low Moor Alloy Steelworks Ltd. and Brayshaw Furnaces Ltd., have been appointed additional directors of Low Moor Fine Steels Ltd.

Two special directors of the Yorkshire Switchgear and Engineering Co. Ltd. have been appointed. They are: **Mr G. E. Lowe,** who has been chief engineer since 1950, prior to which he was chief draughtsman and chief designer successively, having joined the company in 1939; and **Mr A. R. Rumfitt,** A.M.I.E.E., who has been technical sales manager since 1956. Mr Rumfitt joined the company in 1941 as chief test engineer following which he served with the Yorkshire Division of the Central Electricity Authority and returned to the company in 1950 as technical manager.

Mr E. R. Acraman has been appointed a director of Pope's Electric Lamp Co. Ltd. He has been sales manager of the company for the past four years and will continue to be primarily concerned with sales promotion activities.

Chief engineer of A. Reyrolle and Co. Ltd., **Mr W. Gray,** M.I.E.E., A.M.I.MECH.E., has been co-opted to the board of the company. Mr Gray was educated at Sunderland Technical College, and after serving an apprenticeship in marine engineering, was employed by a Manchester firm manufacturing steam and diesel engines. He joined Reyrolle and Co. in 1929, and after service in various sections of the Engineering Department he was eventually appointed engineer-in-charge of the protection and control unit. In 1954 he became assistant chief engineer and four years later was promoted to his present position.

Mr R. C. Ray has been appointed sales manager of Wild-Barfield Electric Furnaces Ltd., his operations also covering the subsidiary, the Applied Heat Co. Ltd. Mr Ray joined the design and drawing office of Wild-Barfield in July, 1937, and continued studies at the Northampton Polytechnic. After service in the RAF, during which he was awarded the D.F.M. and subsequently commissioned, he rejoined the company in 1946 and moved to the sales office, of which he was appointed manager in 1957. Mr Ray's new appointment is part of an internal reorganisation, most of which was carried out earlier this year. Under this **Mr W. R. Brew** became executive manager (engineering), **Mr F. L. Gladwin** was made executive manager (commercial) and **Mr O. V. Metcalfe,** executive manager (production).

Sales manager of Chloride Batteries Ltd., **Mr A. C. Stewart** is approaching retirement age and will not be moving to the firm's Clifton Junction Wks to where the Technical Production and Sales Departments are transferring on 2 Jan. He will be succeeded by **Mr M. A. Griffith-Jones** on completion of the move, but Mr Stewart's services are being retained in a consultant capacity until he retires. Mr Stewart, who has been sales manager since June, 1956, after a year as assistant sales manager, joined the company in 1921 and was for 24 years manager of Drydex dry battery sales.

The Eastern Electricity Board have appointed **Mr A. H. W. Dell,** A.I.M.T.A., as accountant of their Norfolk sub-area in succession to **Mr L. W. Jordan,** A.I.M.T.A., A.S.A.A., A.C.I.S., who has taken up a similar position at the Board's Northmet sub-area (*ESH, page 109). Mr Dell started his career in the Norwich Borough Treasurer's Department, later moving to the West Ham Corporation as personal assistant to the borough treasurer. He joined the Eastern Board and the Norfolk sub-area in June, 1948, in the sub-area accountant's department, being promoted to principal assistant (final accounts) and first assistant to the sub-area accountant in 1952. He recently attended a joint management course at Horsley Towers.

Cable and Wireless Ltd. announce that **Mr A. S. Pudner,** M.B.E., A.M.I.E.E., A.M.B.I.R.E., formerly area engineer, West Indies, is to be an additional assistant engineer-in-chief. In addition, **Mr R. A. Rice,** A.A.C.C.A., assistant accountant, is to be deputy chief accountant in succession to **Mr A. J. Silwood,** who retires on 31 Dec., 1960. **Mr W. I. Mercer,** A.A.C.C.A., will be assistant accountant in place of Mr Rice, and **Mr P. A. McCann,** head of Traffic Circulation Section, is to be an assistant traffic

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* *Denotes revision to the "Electricity Supply Handbook, 1960."*

manager in succession to **Mr V. A. Williams,** who also retires on 31 Dec. Mr Pudner joined Cable and Wireless Ltd. in January, 1934. His first overseas posting was to Bermuda as assistant engineer in 1938 and, after a short spell as assistant electrician on a cable ship, he served in Athens and Haifa. He went to Korea in 1950 to be assistant engineer in charge of the company's field wireless unit. In 1952 he was awarded the M.B.E. for carrying out duties in Korea far beyond the call of duty. Later he served in Hong Kong and, in August, 1958, he was appointed branch and area engineer in Barbados, visiting many of the company's stations in the West Indies. He returned to England on 4 Dec. to the Engineer-in-Chief's Dept.

The Crown Agents for Oversea Governments and Administrations have appointed **Sir James Farquharson,** general manager, East African Railways and Harbours, as engineer-in-chief in their office to succeed **Sir Reginald Taylor,** who retires on 30 April next.

The Minister of Power has reappointed **Mr D. Bellamy,** C.B.E., D.L., F.C.W.A., COMP.I.E.E., F.R.ECON.S., F.S.S., as chairman of the Yorkshire Electricity Board for a further period of one year. **Ald P. Buchanan,** J.P., is retiring from part-time membership of the Board at the end of December on completion of his term of office (*ESH, page 141). Mr Bellamy has been chairman of the YEB since early in 1952, having previously been manager of the Board's No. 6 subarea.

Deputy overseas manager to British Insulated Callender's Cables Ltd. since 1957, **Mr T. E. H. Birley,** O.B.E., has retired after 40 years' service with the company. Born in Manchester in 1898 and educated at Marlborough and Pembroke College, Cambridge, where he won a Classical Scholarship in 1916, Mr Birley served as a pilot in the Royal Flying Corps and joined Macintosh Cable Co. Ltd. in 1920. He transferred to British Insulated Cables Ltd. in 1936 when Macintosh became absorbed by the BI Co. and served that concern on many trade association committees until the outbreak of war. From 1942 to 1945 Group-Captain Birley, as he then was, was assistant secretary on the War Cabinet Secretariat in Washington and for his services there he received, in 1947, the American Legion of Merit—Degree of Officer. The importance of his work in America was also recognised in the 1946 New Year's Honours list by the award of the O.B.E. After the war he returned to BICC as special representative on overseas sales and in 1950 became regional manager for Central and South America.

Well known in the electrical accessories field, **Mr P. E. Wheatland** has retired from the General Electric Co. Ltd. after 47 years' service. He started with the company in 1913 and, rejoining them after war service, worked in the various sales departments. To gain experience he then spent some time with his family contracting business and with Servial Refrigerating Co. He became assistant manager of the Electrical Accessories Department of the GEC in 1946 and, subsequently, was appointed manager in 1949. In 1958 he was made deputy manager of Installation Equipment Division. Mr Wheatland was a member of the BEAMA Accessories Section Standing Committee and was chairman for one year. He also served on the AMEWA, the SSFG Section Standing Committee, the NICEIC and was a member of the BSI for ELE/4. He was also the company's representative on the Fair Trading Council. Mr Wheatland's chief hobby is his garden and, on his retirement, his many friends in the company subscribed towards a fully equipped greenhouse for his new home at Ringwood, Hampshire.

Three staff promotions at the Electrical Research Association are announced. **Mr L. Gosland,** B.SC.(ENG.), M.I.E.E., becomes deputy director, in addition to his position of research manager which he will continue to hold; and **Mr C. G. Garton,** M.I.E.E., and **Mr E. W. Golding,** O.B.E., M.SC.(TECH.), M.I.E.E., M.AM.I.E.E., are appointed assistant directors. Mr Garton will continue as head of the Materials Department of the ERA and Mr Golding will continue as head of Rural Electrification and Wind Power Department and also as overseas liaison officer. Mr Gosland was educated at Tain Royal Academy, Ross-shire, and Glasgow University. He did his electrical training with Barr and Stroud, Glasgow, and joined ERA in 1925. He is chairman of the Commission Mixte Internationale pour la Protection des Lignes de Telecommunications et des Canalisations Souterraines (CMI). He is also chairman of the CIGRE sub-committee on radio and telephone interference and has been a member of the committee of the supply section of the IEE. Mr Garton, who is currently chairman of the Measurement and Control Section of the IEE, was educated at the Rugby College of Technology and received his industrial training with British Thomson-Houston. He was with the All Union Electro-Technical Institute in Moscow from 1933 to 1937 when he joined the ERA and has been head of their Materials Department since 1946. Mr Golding was educated at the Manchester College of Technology and received his early training with Metropolitan-Vickers. He has been with ERA since 1945. Prior to this he was a lecturer in electrical engineering at Nottingham University. Mr Golding is a member of the Arid Zones committee of UNESCO and numerous other associations. He has written several standard text-books and has travelled extensively, being particularly well known for his activities in connection with rural electrification and wind power.

Mr W. T. James has resigned from the board of the British Electric Traction Co. in view of his impending retirement. **Mr Paul Adorian** has been appointed to the board to fill the vacancy.

Mr Philip V. Summer has announced his intention of retiring as chairman of Dictograph Telephones in June, 1961. It is his intention to remain an ordinary director of the company.

Johnson and Phillips Limited announce that following the retirement of **Mr W. J. Richards,** chairman and chief executive of Johnson and Phillips (Australia) Pty. Ltd., and **Mr F. N. Skinner,** managing director, changes have occurred in the administration of their Australian subsidiary, and that **Mr A. E. Woollaston,** formerly general manager, overseas, has been appointed managing director. Mr Richards and Mr Skinner are both very widely known in Australia in electrical circles and retire after long and distinguished service with the company. Mr Richards joined the J. and P. Australian organisation in 1928 and, after some years as general manager, was appointed chairman and chief executive of all the company's interests in Aus-

Mr T. E. H. Birley

Mr P. E. Wheatland

Mr L. Gosland

Mr C. G. Garton

Mr E. W. Golding

tralia, in November, 1949. It was largely due to Mr Richards' instigation that the switchgear factory at Liverpool, near Sydney, was established. Mr Skinner is retiring for health reasons. He has been with the J. and P. Sydney branch for 29 years and, after many years as manager of the branch, he was appointed managing director of J. and P. (Australia) Pty. Ltd. at the beginning of 1959. Mr Woollaston, who joined J. and P. in 1945 as managing director, now becomes responsible for all J. and P's affairs in Australia. After service with Bombay branch, Mr Woollaston set up the J. and P. manufacturing branch in Karachi and, in 1956, returned to London to take up the post of general manager, overseas, which he held until his recent appointment.

Due to ill-health **Mr William Hill** has resigned from the position of sales director of Burco Ltd., and the company's sales and all sales personnel is now controlled by **Mr Kenneth B. Holman,** general sales manager.

Mr P. Winter has been elected executive director of Easiclene Porcelain Enamel (1938) Ltd.

Mr J. P. V. Woollam has been appointed deputy chairman of Simon-Carves Ltd. He joined the company in 1916 and was appointed a director in 1945 and a joint managing director in 1953. He is also a director of the holding company, Simon Engineering, and of several subsidiary and associated companies.

Technical engineer with Hackbridge and Hewittic Electric Co. Ltd., **Mr H. E. Forrest,** A.M.I.E.E., left last week-end for a five-week visit to India, calling at Bombay, Madras and Delhi before returning to England via Colombo.

Engineer of No. 2 sub-area of the Yorkshire Electricity Board for the past four years, **Mr J. S. Yates,** M.I.E.E., A.M.B.I.M., has been promoted to deputy chief engineer to the Board in succession to **Mr P. C. Phillips,** B.SC., M.I.E.E., who is now the Board's chief engineer, as we earlier reported (*ESH, page 141 and 143). Prior to going to the Huddersfield sub-area, Mr Yates was section head, planning and development, at the No. 2 (Bolton) sub-area of the North Western Electricity Board.

After 40 years' service with Superlamp Ltd., **Mr L. G. Lyon,** a director and general manager of the company, retires at the end of this month. His colleagues presented him with a tape recorder at a farewell party.

General Manager of the General Electric Co.'s Magnet Works, **Mr A. R. Green,** F.C.I.S., is retiring on 31 Dec. after 40 years' service with the company. He started initially in the Accounts Department at Witton and in 1924 became assistant accountant, Engineering Works, Witton. By 1929 he was chief accountant of the Magnet Works and was appointed manager of the works. Mr Green started the Swinton Works in 1945 and acted as joint general manager of the Magnet and Swinton Works. In 1957 he became general manager of both works, but he recently relinquished his post as manager of the Swinton Works. In 1957 he was elected a director of the Parkhall Pottery Co. Ltd.—a GEC subsidiary and from 1957-59 he was a director of the Irish AET Works.

Sales manager with B. and F. Carter and Co. Ltd., **Mr V. L. Pinnock,** M.S.M.A., has been appointed to the board of directors of the company.

OBITUARY

Mr W. W. Cook, M.I.E.E., M.I.C.E., formerly a consulting engineer, died on 16 Dec., aged 93.

NEW LITERATURE

Garcke's Manual of Electricity Supply 1959-60

THE long line of Garcke's Manuals comes to an end with this fifty-seventh edition, but that does not detract from the value of this volume which fully maintains the tradition of its predecessors. The presentation follows that of earlier editions, with a general survey of electricity supply progress in Britain, followed by operational statistics of generating stations, and the area boards down to district level. A section with similar details of undertakings in Scotland and Ireland is followed by financial and other particulars of many manufacturers, a list of associations and a directory of personnel, all compiled with a great deal of care. Originally compiled under the direction of the late Emil Garcke, the Manual has come to be regarded as an institution in many reference libraries and there will be genuine regret at its cessation. Its first edition, published in 1896, a copy of which we still hold in our files, refers to the industry then having upwards of £50 million of capital invested in it, but that included telephone, telegraph and traction companies. How times have changed! And now Garcke's stops. Published by Electrical Press Ltd., 756 pages, 8¼ in. by 5¼ in. Price £4 4s.

Uses of Electricity in the Oil Industry

edited by E. A. W. Reeves, D.F.H., A.M.I.E.E.

ONE of the fascinations of electrical engineering is that it embraces every industry without exception. The engineer of experience may, when changing jobs, find himself in an entirely new field which, electrically, differs little from the last or in one which has its own special electrical problems, hazards, etc., with its established techniques of dealing with them. Such an industry is oil, from drilling, pumping and transporting to processing in the refinery.

Should an engineer be contemplating joining an oil company, this book will be invaluable to him. It is not just a textbook written by an individual; it is a series of contributions by 22 specialists from oil companies, research organisations and manufacturers of electrical equipment for hazardous environments, neatly brought together and prefaced by the editor. There is also much which could equally apply to mining and certain chemical industries. Published by Ernest Benn, 286 pages, 9 in. by 6 in. Price 50s.

Transformers and Generators for Power Systems

by R. Langlois-Berthelot

THIS translation from the original French context by Lt-Col H. M. Clarke, of King's College, is actually two books in a single volume. The first, of 227 pages with 53 pages of references, deals with transformer theory and design; the second, of 161 pages with another 53 pages of references, covers similar aspects of the synchronous machine, both as a single generator or operating in parallel with others. The translation shows little evidence as such; it could easily have been mistaken for the original. The style is concise and the mathematics clear. Though aimed at the student—as a companion to a previous work, *Electro-magnetic Machines*, by the same author—it is also useful to the practising engineer concerned either with design or operation.

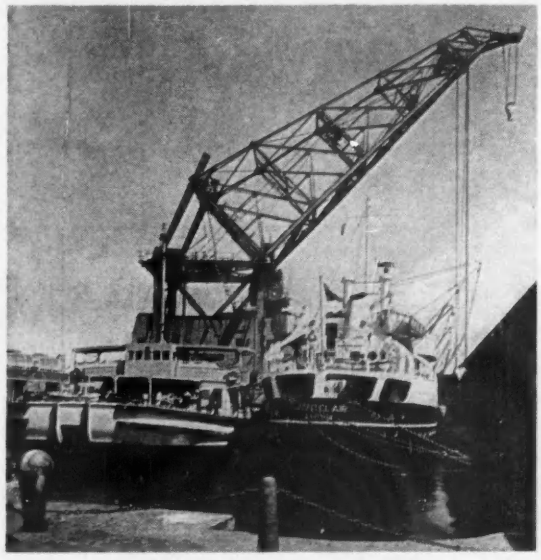
The extensive references are, perhaps, of questionable value to the student who may not have access to them; nor is there much point in leaving some untranslated. One of the clearer textbooks on the subject. Published by MacDonald and Co., 533 pages, 8¼ in. by 5¼ in. Price 65s.

BOOKS RECEIVED

The 15 Wonders of the World, by R. Poirier. Account of 15 major engineering feats in history, ranging from the Tower of Babel and the Pyramids to the Volga and Tennessee hydro schemes and the Oak Ridge atomic power project. Published by Victor Gollanz Ltd., 400 pages, 8¼ in. by 5¼ in. Price 25s.

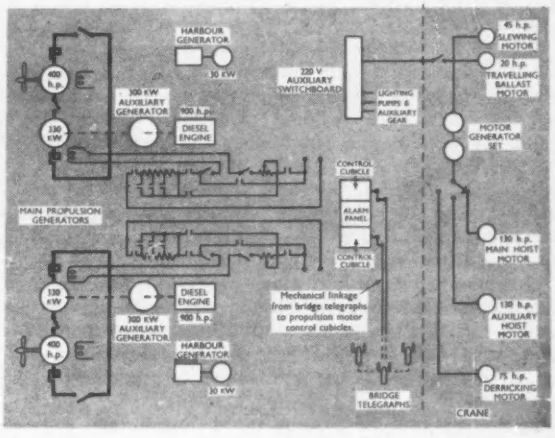
An Introduction to Electrotechnology, by S. J. Kowalski. Text-book for Part 1 Applied Electricity paper for London B.Sc.(Eng.) degree. Published by Chapman and Hall Ltd., 301 pages, 8½ in. by 5¼ in. Price 35s.

Basic Ultrasonics, by C. Glickstein. American book giving elementary introduction to subject, covering equipment and applications. Published by Chapman and Hall, 137 pages, 9¼ in. by 6 in. Price 32s.



60-ton floating crane

ELECTRICAL EQUIPMENT OF THE "SAMSON"



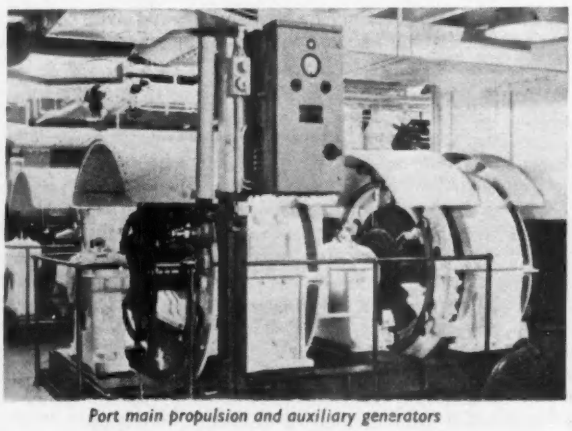
Circuit diagram of crane and propulsion equipment on the "Samson"

THE new 60-ton twin-screw floating crane "Samson," commissioned earlier this year by the Mersey Docks and Harbour Board for Liverpool Docks, is diesel-electric powered with electrical equipment supplied by the GEC. The hull has an overall length of 183 ft, a breadth of 56 ft, and the crane has a capacity of 60 ton up to a radius of 78 ft 8 in. with an auxiliary hoist of 25 ton up to a maximum radius of 93 ft 8 in. A power-driven counterbalance and derrick hoist is also incorporated.

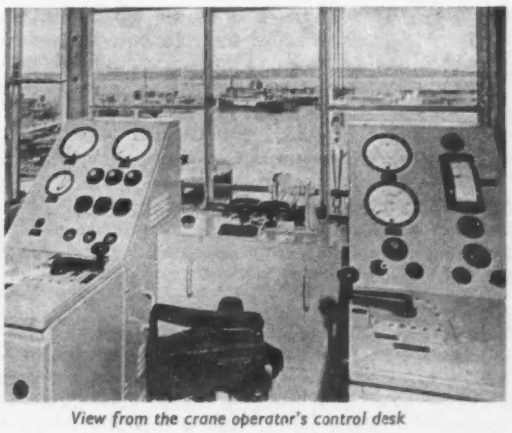
Propulsion is by two 400 h.p. motors with Ward-Leonard control supplemented by a 200 h.p. bow-steering pump capable of exerting a two-ton thrust in either direction. Control of propulsion is from engine-room telegraphs on the bridge mechanically linked to the panels in the engine-room, with facilities for local control.

Power for the 130 h.p. crane hoists and the 75 h.p. derrick motor is obtained from a 107 kW Ward-Leonard set. Slewing and ballast motors, the former of 45 h.p. and the latter of 20 h.p., are series wound and are supplied from the 220 V auxiliary generators. At the crane control desk a central three-position switch enables either of the crane hoists or the derrick motor to be selected for control from the lever type, nine-notch controller which operates on the separately- and self-excited fields of the Ward-Leonard set. On the console to the right is the control for the ballast motor with, above, the instruments and ballast position indicator; on the left is the slewing motor control with, above, hoist selector indicator lights, Ward-Leonard controls and limit switch override buttons.

The two main generators are rated at 330 kW, 440 V d.c. and these supply the propulsion motors. They are driven by 900 h.p., 600 r.p.m. Paxman YLXZ diesel engines, to which they are coupled by Twiflex articulated flexible couplings. Also on the same shaft are the 300 kW, 220 V auxiliary generators which supply the crane hoist sets and other motors. The rating of the latter is such that a single generator is capable of supplying the entire crane and service load. Two 30 kW, 220 V diesel sets provide power for essential services when the main units are shut down. All electrical equipment is fully provided with protective devices.



Port main propulsion and auxiliary generators



View from the crane operator's control desk

Conductor stringing calculations

DETERMINATION OF TEMPERATURE DIVIDING LINE

by E. M. Clackson

SINCE the advent of suspension-type construction in the form of wood pole transmission lines, there has been a tendency to deviate from the generally accepted equivalent span method of conductor stringing. This tendency may primarily have its origin in the rather lengthy calculations required to produce an equivalent span sag and tension chart which, in turn, demands a considerable amount of careful interpretation on the part of the field engineer. Secondly, there is always the possibility that theoretically rigid shackle poles will require the added expense of stays to deal with unbalanced loading due to unequal equivalent span sections.

The alternative method which appears to have received considerable attention in the industry is to tension the conductors throughout the whole length of the line to the equivalent tension of the complete line (equivalent line) or to the same tension that would be obtained in the maximum single span. This method, while more economical in some respects, will result in the maximum working tension being exceeded under certain conditions and the minimum factor of safety required by the Electricity Commissioners not being attained.

This statement can be substantiated by a glance at almost any sag chart of the equivalent span type, from which it is evident that at some temperatures the tension will be greater in the smaller spans while at others, where the temperature curves slope in the opposite direction, the tension will be greater in the larger spans. There is, in fact, a definite dividing line somewhere in the temperature curves where tension is constant, irrespective of the equivalent span. If this dividing line is above the highest practical erection temperature, the alternative stringing method could be used with safety. Where the dividing line is somewhere within, or even below, the normal range of erection temperatures, it would be dangerous to do so.

Some will maintain that the alternative equivalent line method is more desirable in view of its simplicity but it must be borne in mind that each section of line between shackle positions will, after erection, react in a fashion similar to the equivalent span of the section and not to the equivalent tension of the complete line. This will again cause out-of-balance loading at shackle positions and considerable deflection of the insulator strings, particularly when subjected to adverse weather conditions.

If the alternative method is considered, before preparing sag charts and templates, etc., for a proposed line, it is expedient to determine the exact temperature at which the tension will remain constant irrespective of span length, i.e., the dividing line. This can be found by referring to the basic formula used to determine tension variations due to altered loading:

$$(C_1W_2L/T_2)^2-T_2=(C_1W_1L/T_1)^2-T_1+C_2t$$

where $C_1=\sqrt{EA}/24$ (A is the conductor area in sq in., E is the elastic modulus of the conductor); $C_2=aEA$ (a is the coefficient of expansion); W_1=weight per foot run of conductor when fully loaded at T_1, the maximum working tension; W_2=weight per foot run of conductor and T_2=the conductor tension when the temperature has risen or fallen by $t°$; L=the length of the span.

Any variation in weight per foot run through thermal expansion or contraction and/or icing will produce a corresponding variation in tension and it can be shown from the sag formula, $S=WL^2/8T$ that, for a given conductor, W/TS is a constant when in an isolated span. But at the dividing line temperature, the sag is equal to that obtained at the initial condition and W/T is a constant irrespective of span length. As a result, the two quantities in brackets in the above formula are mathematically identical in this particular application, therefore it can be reduced to:

$$T_2=T_1-C_2t$$

That is

$$t=(T_1-T_2)/C_2$$

and, of course,

$$T_2=(T_1W_2)/W_1$$

Let us consider a practical example. Assuming an 0·175 sq in. s.c.a. conductor (37/·110) with $\frac{1}{2}$ in. ice and 8 lb wind at 22°F and a maximum working load of 4,000 lb. Then $W_1=1·2175$ lb/ft, $W_2=0·57$ lb/ft and $C_2=47·97$. On this basis

$$T_2=(T_1W_2)/W_1$$
$$=(4{,}000\times·57)/1·2175$$
$$=1{,}872\text{ lb}$$
$$t=(T_1-T_2)/C_2$$
$$=(4{,}000-1·872)/47·97$$
$$=44·35°F$$

Therefore, the dividing line will be 44·35°F above the initial temperature; that is, 66·35°F.

Let us now prove the example by finding the tension at 66·35°F in spans of 200 ft and 500 ft using the formulae. For a 200 ft equivalent span,

$C_1=441·5$

$C_1W_2L=50{,}330$

$(C_1W_1L/T_1)^2=722$

$C_2t-T_1=-1{,}873$, $(C_1W_2L/T_2)^2-T_2=-1{,}151$

For $(50{,}330/T_2)^2-T_2=-1{,}151$, $T_2=1{,}872$ lb.

In this last equation the tension T_2 is normally found by trial and error on a slide rule: from the example we know the tension should be 1,872 lb.

For a 500 ft equivalent span,

$C_1W_2L=125{,}800$

$(C_1W_1L/T_1)^2=4{,}515$

$C_2t-T_1=-1{,}873$, $(C_1W_2L/T_2)^2-T_2=2{,}642$

For $(125{,}800/T_2)^2-T_2=2{,}642$, $T_2=1{,}872$ lb.

The dividing line of temperature is, therefore, 66·35°F.

This particular example shows that it would be unsafe to use the alternative stringing method, as erection temperatures well in excess of 66·35°F are prevalent in this country. There are, however, many conductors where the physical properties and loading conditions are such that the dividing line will be well above the range of erection temperatures, which does suggest some measure of justification for the tendency to deviate from the equivalent span method of conductor stringing.

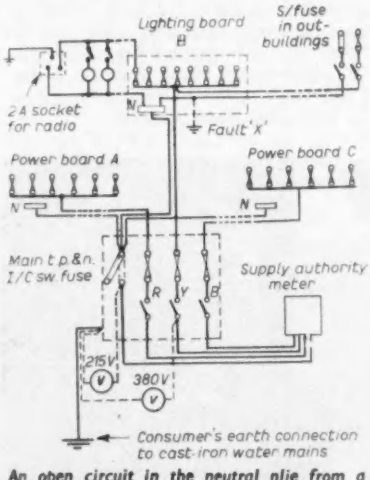
PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Lighting Circuit Hazard

CALLED to rectify a fault on a lighting installation in a country house, I was as alarmed as the owner when he told me that, on the previous evening, when switching on the hall light, it had glowed excessively brilliantly and then burned out. When this happened on other circuits he wisely pulled off the main switch and sent for me. Moreover, the maid reported that, on the previous afternoon, she had switched on a radiogram and smoke came from the back of the instrument. Wisely, she switched off and drew out the plug, thinking that the flex had broken down. The lighting installation had previously been supplied from a private generating set but had been changed over to the public supply and was now fed from a pole-mounted transformer, three-phase four-wire, which also fed an adjacent farm.

I withdrew all fuses and checked the volts between incoming neutral, phases and earth. The meter indicated no volts between the red phase and earth, 215 V between neutral and earth and 380 V between yellow and earth. I immediately advised the supply company who sent an engineer post haste to the scene. I afterwards was told that the star point earth connection on the transformer had been found faulty while, at the farm, there was an earth fault on the red phase somewhere in the consumer's installation. As the diagram shows, this can lead to dangerous voltages on a consumer's premises where there is no fault.—*E.L.O.*



An open circuit in the neutral nlie from a pole-mounted transformer plus an earth fault on another consumer's premises creates hazardous voltages on a domestic installation

Low Voltage Lampholders

THE extending practice of using low voltage lighting on machine tools, etc., wholly to be commended, has, however, its own problems. Chief of these are the softening of solder on the lamp contacts, failure of plunger springs and the use of unventilated metal shades.

The temperature reached in low voltage lampholders is, to the uninitiated, rather surprising. In one case a 6 V 18 W s.b.c. auto bulb mounted in a small unventilated metal shade carried on an adjustable arm reached a temperature far in excess of that which could be touched with safety and was certainly in excess of the melting point on the soft solder on the lamp contacts. Admittedly the ambient temperature was high by reason of the motors, pumps and heaters which were part of the related machine tool installation.

The first step taken was to replace the soft solder on the lamp contacts by h.m.p. solder. This was done at our request by the lamp makers and initially reduced the number of failures. Ultimately, however, the plunger springs failed presumably under the combined heating effects of the 3 A current and excessive lamp cap temperatures. The final cure was to fit small edison screw holder, using s.e.s. lamps with the same lampshades. It is essential to realise that the conditions are vastly different from those in motor car headlamps for which the bulbs and holders were originally designed.—*F.S.*

Earth-free System Faults

A "FAULT in the Dark" (page 813 24 Nov.) could have been brought to light much sooner, a busy service engineer employed on more important work and the voltage regulator left undisturbed by the installation of a simple and effective earth leakage indicator.

Used extensively on unearthed d.c. systems, it consists of two lamps of equal voltage in series across the busbars with the centre connection earthed. Any number of these indicators may be installed. For example, one should be sited at the generator room with others at vantage points throughout the building. Fault indication is shown as follows: An earth-free condition would be indicated by both lamps being of equal brightness. An earth fault brought about by an earth on one busbar would be indicated by unequal brightness, the resistance of the earth fault determining the amount of difference in lamp brightness. A high resistance fault would show as minimum difference and a low resistance fault as a practical extinction of one lamp and full brightness on the other. A broken filament in one indicator would show as a fault condition on others but this is rare because the lamps normally operate at half system voltage. —*Centri.*

Ion Replies—

Had such a form of indicator been installed in the laboratories, it would not have disclosed the fault earlier for the simple reason that its location lay at a mid-point between the two busbars—i.e., between the 50 V lamp and 60 V dropper resistance and so corresponds to the earth connection of another two-lamp indicator in parallel. By the same reasoning, an earth fault on the mid-point of a motor shunt field winding would not be disclosed until a second fault arose. With all such devices, there is no positive indication of faults occurring at or near the mid-potential point on a system. The only safe indicator is an earth leakage indicator inserted in one earthed bus-connection and, in fact, this was what was eventually installed. Incidentally, it is important to realise that two apparently identically voltage-rated lamps in series across a higher voltage system do not necessarily glow with equal brightness. They have to be selected on their current rating as anyone who has had experience of series lamp circuits on traction voltages will know. All such lamps are rated for current, not voltage alone.—*Ion.*

That Man Again!

LAST year I gave you my tip on the use of test-lamps. Here is another useful pointer. As a maintenance engineer I am mystified by some of the antics recommended in these columns to dry out electric motors which have become immersed. My method is to switch it on and keep it running. Sometimes the motor dries itself out but, usually, of course, goes up in flames. Then I send it to be rewound and it is as good as new.

Another useful tip in locating faults. If a fault on, say a lighting circuit, will persist in blowing fuses, instead of trying to locate the fault, put bigger and bigger fuses in until something happens. Sometimes the current will blow the fault clear; on others a shower of sparks will give away the fault position.

That reminds me. Does anyone want a maintenance engineer? My firm has just been gutted by fire.—*M. E. N. Ace.*

equipment for industry

Resin-bonded glass-fibre tubes

TUBULAR components manufactured from resin-bonded, helically wound glass-fibre rovings are being developed by Permali Ltd. for electrical applications. Technique used enables production of tubes from 1 in. to 4 ft 6 in. dia in lengths up to 20 ft. Among advantages claimed is that maximum strength of the material can be developed in any particular direction to suit the mechanical design of the component to be manufactured. Typical applications are transformer tanks and turbulator pots for high voltage circuit-breakers. *Permali Ltd., Gloucester.*

General purpose gas turbine

NOW being distributed in this country is the US built "Saturn" gas turbine, a general purpose main or auxiliary power unit. It has a continuous rating of 1,250 h.p. at 20,000 r.p.m. with a fuel consumption of 0·6 to 0·63 lb/h.p. hr. The machine is claimed to operate efficiently on a number of fuels including petrol, paraffin, diesel and natural gas and to give quick and reliable starting under a wide range of climatic conditions. Suitably geared-down, the unit should find useful application as a prime-mover for standby electric generating sets. The "Saturn" weighs only 950 lb and has overall dimensions 69 in. long by 45 in. wide by 44 in. high. *Perkins Gas Turbines Ltd., Peterborough.*

Digital volt/ohm meter

TRANSISTOR circuitry techniques are made use of in a recently introduced instrument which can measure voltages from 1 mV up to 1·1 kV and resistance to 1·1 megohm. Readings are displayed in digital form on a lamp-projection type indicator on the front of the instrument. Alternatively, there is provision for coupling to a line printer or reperforator unit, made by the same company, which will permanently record readings. The instrument thus lends itself to incorporation in data logging systems. Price is £385. *Venner Electronics Ltd., Kingston Bypass, New Malden, Surrey.*

High-speed batch counter

AN electronic batch counter with dekatron presentation and capable of counting at a maximum rate of 500/sec using photo-electric viewing heads, is a recent addition to the Elcontrol range of industrial electronic instruments. The total count is displayed up to a maximum of 9,999 and automatic reset features are incorporated. The counter is 9 in. deep by 16 in. wide by 13 in. high. A smaller counter, the BC2, with cyclometer presentation has a rate of up to ten counts/sec. *Electronic Control Engineers, Wilbury Way, Hitchin, Herts.*

Miniature wander-plug and socket

DESIGNED specifically for use with printed circuits, the new "Clix" miniature wander-plug and socket has dimensions conforming with the standard 0·1 in. module. Thus, the socket body has a diameter of 0·19 in., making it suitable for mounting on 0·2 in. centres, while the socket mounting pin is 0·05 in. dia and 7/64 in. long. The plug body is $\frac{5}{16}$ in. long by 0·19 in. dia and has a 0·04 in. dia $\frac{1}{4}$ in. long contact pin. Bodies are in moulded red or black nylon and contact surfaces are silver plated. *AEI Radio and Electronic Components Division, 155 Charing Cross Rd, W.C.2.*

The Digilog

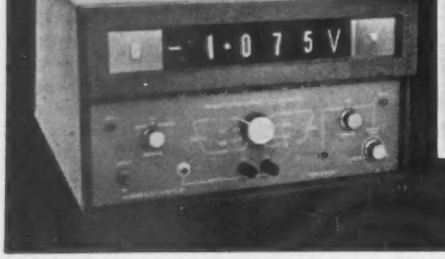
THE Digilog is a metering device for collating analogue signals from a number of sources, converting them to digital form and presenting the results in schematic form on a chart. In addition, any readings which depart from a predetermined safe level are printed in red or, alternatively, it could be so arranged to print only when such levels were exceeded. The chart recorder has been specially developed to withstand continuous 24-hr operation and the system can be applied to such tasks as monitoring the temperature distribution pattern in nuclear reactors. *Bailey Meters and Controls, Purley Way, Croydon.*

Drum heater

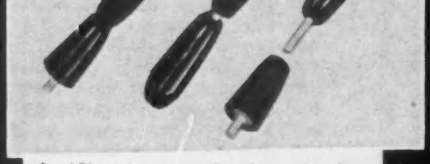
A ROBUST accessory for applying heat to drums containing materials which are viscous or solid at normal ambient temperatures, thereby facilitating emptying, the "Electrothermal" drum heater is in the form of a 5½ in. wide band of stainless steel held closed by a stout coil spring. It will encircle drums ranging in diameter from 22½ in. to 23½ in. An enclosed electric heating element rated at 2 kW, 200 V to 250 V, provides the heating and it has been designed specifically for 40 gall to 50 gall capacity drums. The weight of the unit is 9 lb and the price, £21. For controlling one or three heaters, energy regulators are also available. The single-element regulator is priced at 65s; the three-element unit at £9 2s 6d. *Electrothermal Engineering, 270 Neville Rd, London E.7.*

Cam-operated switch

A RECENTLY introduced switch has two leaf-spring contacts operated by a shaft-mounted cam. Rating of the contacts is 1 A at 110 V, or 2·5 A at 24 V, non-inductive and the shaft, supported by sealed bearings, can be driven at high speeds. The unit was primarily designed for use in conjunction with an electro-magnetic counter, but with an alternative cam form it is claimed to be particularly suitable for limit switching of rotary valve actuators. The unit is housed in a splash-proof light alloy casing suitable for either foot or flange mounting. *Lancashire Dynamo Electronic Products Ltd., Rugeley, Staffs.*

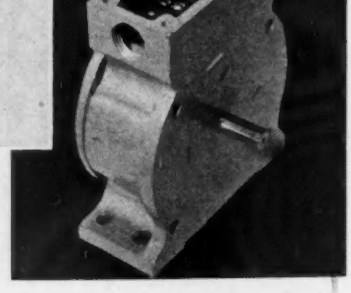


Venner digital volt/ohm meter can measure voltages from 1 mV to 1.1 kV and resistance up to 1.1 megohm



▲ *AEI miniature wander-plug and socket is dimensioned to suit 0.1 in. module printed circuits*

High speed cam-operated switch by Lancashire Dynamo has a splash-proof light-alloy housing ▶



for the electrical trade

Packs of lighting diffuser panels

A RANGE of 2 ft square diffuser panels is announced consisting of six designs in handy boxes of six each. The panels are of translucent plastics and are suitable for displays, stores, offices and eventually, the makers hope, the home. The designs comprise one plain model and five patterned. Prices of the new panels, identified from Type A to Type F, are £8 18s 3d, £9 12s 6d, £9 16s 9d, £10 6s 3d (two models) and £12 19s 3d per pack. *Courtney, Pope (Electrical) Ltd., Amhurst Park Wks, Tottenham, N.15.*

Fan for local extraction

AN extractor fan designed to provide ventilation for comparatively small spaces has just been introduced. It is suitable for installation in kitchens, directly over or as near as possible to cookers, to remove odours and fumes almost at their source. The whole assembly is contained in a metal box 9¾ in. square overall, with internal and external louvres to be fixed flush with the wall after installation.

The fan on/off cord switch is linked with the internal adjustable louvres and thus the fan operates automatically when the louvres are opened. This switch has a half-position for partly opening the louvres when ventilation without extraction is required. Outer aluminium grille is fully weathered and supplied anodised if required. The impeller fan itself is three-bladed and formed from plastics. A speed regulator, M.75, is recommended as an optional extra. This regulator has a housing of stove enamelled aluminium and should be wall-mounted adjacent to the cooker which the extractor serves. Gross weight of the fan unit is 18 lb 7 oz. "Mechavent 75" Mark III. Price £12 17s 6d. *Greenwood's and Airvac Ventilating Co., Beacon Hse, Kingsway, W.C.2.*

Electroluminescence

WHAT was probably the first domestic application of the electroluminescent light source was described on this page in 17 Nov. issue when we described a new device for locating switches and sockets in the dark. We are now able to illustrate the locator and, below, are pictures of its interior and of an actual installation. In normal light it is a square white panel, but in darkness, when connected, the transparent outer frame glows bright green—highlighting the fixture screwed to its face. The panel will accommodate any accessory having 2¾ in. fixing centres.

It may be remembered that the new light source came into the news some months ago when an American manufacturer introduced a small circular night light utilising the phenomenon. Even more recently the same maker produced an even larger, square version. Current consumption of these panels is infinitesimal.

The new locator, which is 3¼ in. square, is modestly priced at 5s 8d. *M.K. Electric Ltd., Shrubbery Rd, N.9.*

Fan heater with 360° outlet

A FAN heater, introduced recently, expels heated air through 360°. This is a 2 kW heater of the type employing a horizontally mounted fan impeller. Warm air is expelled from the upright cylindrical casing through louvres which extend all round the unit. The heater is controlled by a four-position switch, giving 1 kW, 2 kW, "fan only," and "off." It includes the usual safety cut-out which operates in the event of fan failure or on obstruction of the air supply, and has an internal lamp to indicate when the element is on. The steel casing is stove enamelled in four combinations, light and dark grey, grey and yellow, blue and grey and black and off-white. It stands 15¼ in. high and is 14¼ in. in dia. Price of the new heater, known as "Sunset," is £11 5s, tax paid. *Best Products, Ranelagh Hse, Felixstowe, Suffolk.*

TRADE PUBLICATIONS

STATOMAT. — Descriptive folder on a machine for the automatic lacing of stator windings. Southern Tools, 22 Upper Mulgrave Rd, Cheam, Surrey.

MORGANS.—Booklet KJ 83 illustrating products of The Morgan Crucible Co., Battersea Church Rd, S.W.11.

COPES.—Four-page leaflet No. P1007, describing systems of desuperheating and pressure reducing. Copes Regulators, 9 Southampton Pl, W.C.1.

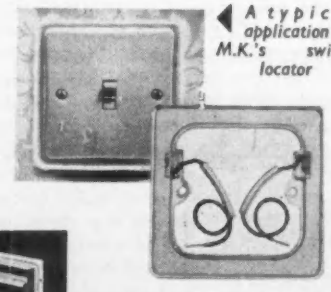
BULGIN.—Leaflet describing new range of moulded, single-pole rocker-contact switches with central "Off" position. A. F. Bulgin, Barking, Essex.

E.M.I.—Short form illustrated catalogue of products from the instrument division. Oscilloscopes, stroboscopes, closed circuit television, electronic photographic equipment, nuclear health instruments, analogue computers and instrumentation tape decks. E.M.I. Electronics Ltd., Instrument Division, Hayes, Middx.

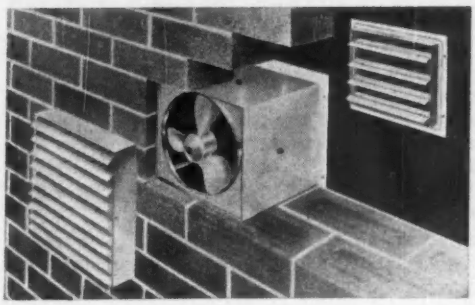
THERMOFLASH. — Eleven-page illustrated brochure describing water distillation plant, land based and marine units. Bennis Thermoflash Ltd., Little Hulton, Walkden, Manchester.

HYFLO.—Illustrated technical folder describing control switches for liquids: open cup type and glass-tube type. A. Kingsley Williams, Victory Wks, 4-10 Newbold Rd, Chesterfield.

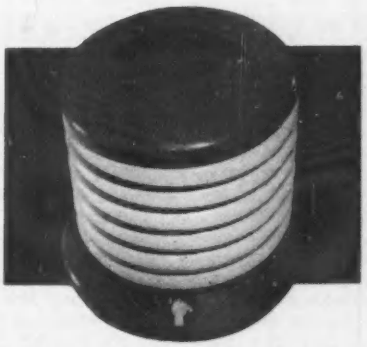
KABI.—Leaflet describing Duralumin containers, tailor made to customer's specification. Also leaflet on industrial tapes, including electrical insulating tapes, double-sided self-sticking. Kabi (Electrical and Plastics) Ltd., Kabi Wks, Cranborne Rd, Potters Bar, Middx.



A typical application of M.K.'s switch locator



The electroluminescent light source applied to a domestic switch locator. Interior view shows two leads and resistors which are connected across line and neutral terminals. Consumption is negligible



An exploded view of the "Mechavent-75" Mark III extractor fan. Complete assembly sells at £12 17s 6d

"Sunset," a fan heater with 360° air flow. £11 5s

Transformers in court

SUPPLY ENGINEERS GIVE EVIDENCE OF MORE ORDERS FOR INDEPENDENT MANUFACTURERS. PRICE LEADERSHIP POSSIBLE?

SUPPLY industry engineers have been prominent in the list of witnesses during recent hearings before the Restrictive Practices Court of the Transformer Manufacturers' Association case. When counsel for the Registrar of Restrictive Practices had concluded his opening address to the Court, the first witness was Mr J. Eggington (chief transmission engineer, CEGB). Asked if he agreed that quality of British transformers could not be surpassed by manufacturers in other countries, he said he had no knowledge of the quality reached by manufacturers abroad. However, he agreed that research and development work carried out by TMA members was of a high standard. Moreover, he had visited, during the last three years, the works of nearly all the members of the TMA and, generally speaking, had found the standard of efficiency to be high.

He agreed that there had been a price war in the transformer industry during the years 1928 to 1930 and that there was a risk of something like that happening if the TMA agreement were brought to an end. In any future price war, money made available for research and development would be reduced, but he doubted if it would be withdrawn altogether.

Mr Eggington was succeeded as a witness by Mr L. Miller (chief purchasing and contracts officer, CEGB). He agreed that if there were a free market and the CEGB were dissatisfied with the level of prices, then they had the power to go to a manufacturer and, against a guarantee of orders, get him to reduce his price. However, it was unlikely that such a set of circumstances could arise in conditions of free competition.

Mr Miller said he would expect the CEGB to watch price levels from two points of view. First, if prices were so low as to cause concern about quality of transformers; and secondly, from the aspect of reduced prices endangering production capacity in the country. If the price-fixing agreement of the TMA were abandoned, the CEGB would put manufacture of all its transformers out to tender.

Mr E. Long (board member, CEGB) thought there was no real likelihood that the capacity of the industry in England would be insufficient for the requirements of the Board. If it were thought that price levels were unreasonable, the Board would hold discussions with manufacturers and would always take such action as would help secure and maintain a healthy manufacturing industry. He did not think that conditions existing between 1927 and 1930, which caused a 40% price drop, bore any resemblance to conditions today.

Mr G. Nicholson (chief engineer, Yorkshire EB) said that if manufacturers were in competition and prices were "too low" his first concern would be about quality. The YEB considered it very important to have a first-class article and they would be much concerned at the possibility of deterioration in quality. Mr R. Sully (purchasing officer, Southern EB) said that in each of the four years 1956-57 to 1959-60 his Board had bought more category A transformers from independent manufacturers than from Association members. It was possible, he said, that although during this period TMA members had reduced their prices, other manufacturers had dropped theirs still further to retain a major part of the business. Mr A. Proctor (assistant chief engineer, SWEB) told Mr Justice Russell that he found considerable variation in prices quoted by independent members for category A transformers.

Mr L. Turner (purchasing officer, Midlands EB) said that independent manufacturers had substantially increased their share of business from his Board, but most of the business still went to TMA members.

Non-member Manufacturers

Mr F. Lydall (managing director, Yorkshire Electric Transformer Co.) said stability in the industry could be achieved by price leadership, in which leading manufacturers would draw up a schedule of prices considered to be economic and make this schedule available to other manufacturers as a guide.

Mr. S. Brewer, (director, Bryce Electric Construction Co.) said that in his view, there was at present a price war in the transformer business. In earlier submitted evidence, he had said that he did not think the price war would result in any deliberate sacrifice of standards, but that there had already been a reduction of "margins". He explained this by saying that particularly in the case of smaller transformers, but also in other cases, designs had been pressed to minimise prices.

On the question of the fall in export sales, he said that to compensate for the fall, he had been compelled to concentrate on the home market, without relaxing efforts to obtain export orders. Asked about discovering why any particular order had been lost, he said the electrical industry was a friendly one, and he would expect to hear from a customer if he had erred in any way.

Prof. F. Paish, an economist, agreed that the export market fluctuated, and could be very unprofitable; but it could expand.

The case so far . . .

The ten-member Transformer Manufacturers' Association is defending before the Restrictive Practices Court its agreement providing minimum prices for transformers sold for use in the UK. Witnesses for the Association have drawn attention to under-employment of the capacity of the industry at present and have underlined its difficulties in selling overseas. They have also described tentative negotiations by individual members with non-member firms in an attempt to extend Association membership. Accountants and economists have described the working of the TMA price-fixing agreement, and have said that without it home prices would fall. The case began on Monday, 21 November, and is now entering its final stages.

News of the Week

No I.o.W. Nuclear Station yet

West Sussex site technically unsuitable

ALTHOUGH detailed technical investigations have shown that Hamstead, IoW, is "excellent" for the site of a nuclear power station, the CEGB have decided to defer any decision about seeking consent for such a station. In a statement issued last week the Board say that the site at Earnley, West Sussex, which was considered a possible alternative to Hamstead, has proved technically unsuitable for development.

It was in February, 1959, that the CEGB announced their intention of carrying out detailed investigations of the two locations, because of the urgent need to explore ways of expanding generating capacity in the central southern area of England. The proposal immediately raised objections, particularly with reference to the Hamstead site on the Solent a few miles from Yarmouth, IoW. Recently, land near the proposed site passed into the ownership of the National Trust.

In their statement the Board point out that demand for electricity in the southern counties is growing at a rate of 10%/year, almost half as much again as the average for the whole of England and Wales. This demand can be met by building stations in the Midlands, with bulk transmission to the south coast. But the Board are reluctant to adopt the second alternative too widely, both because of their policy of minimising mileage of transmission line and also because "the construction of power stations in the Midlands is not universally welcomed."

For the types of nuclear power station at present being built, only two potential promising sites between Dungeness and Weymouth have been found, that at Earnley and that at Hamstead. Earnley is unsuitable for present types of reactors and is "unlikely to be attractive" for future types of reactor. However, Hamstead is suitable in all respect on technical grounds and the Board believe that they could build a station there with little real damage to amenity. They are deferring any decision about seeking consent for the site, rather than abandoning all possibility of its use.

It would be possible to meet immediate power demands in the southern counties, while minimising transmission, by building a conventional power station at Southampton Water. However, this would have the disadvantage of increasing materially the cost of power in the area of the Southern Electricity Board as compared with alternative schemes. The CEGB say they need more time for the consideration and investigation of conventional alternatives.

ANOTHER SUFFOLK STATION SITE?

SEEKING a site for a possible future power station, the CEGB wants to take over Landguard Point, on the Suffolk coast, near Felixstowe. The property is held by the War Office and negotiations are now proceeding through a Parliamentary Committee. No decision has yet been made of the type or size of power station which would be erected if the site is acquired. For several hundred years there has been a fort on the site, standing guard over Harwich harbour, and the present buildings were erected in 1875. Of course, there is said to be a ghost, which alarms sentries at night!

The garrison was withdrawn from the fort in June, 1957, and since then has been used only for the summer training of Territorial Army units.

DELAY ON COLOUR TV

GOVERNMENT approval for a BBC scheme to start an experimental public colour TV service next November will not be forthcoming, said the PMG in the House of Commons last week. He said it would be a "profound mistake" for the Government to make a decision on colour TV before the future lines standard (whether to change from 405 lines) had been decided. The director-general of the BBC, Mr H. Carleton Greene, has commented that it believed that technical problems of technically satisfactory colour TV receivers might well be solved some years in advance of substantial use of a new system at a higher lineage. Sets to the 405 line standard for colour would have had at least six to ten years' life.

TAKEOVER BIDS

The clothes dryer firm, A. J. Flatley Ltd., are involved in discussions on a takeover bid. Mr A. J. Flatley, chairman and managing director, confirmed that talks were taking place, but he could not reveal the name of the party involved as nothing was finalised, he told the ELECTRICAL TIMES on Monday.

From his offer of 6s 6d per share last June, Mr Colin Will now holds approximately 74% of the capital of E. Shipton and Co. (Holdings) Ltd., telephone and signalling engineers. The board has been reorganised and now comprises Sir Leslie Nicholls (chairman), Mr E. Shipton (vice-chairman), Mr C. Will (managing director) and Mr V. Younger.

Range Boilers Ltd. have purchased the whole of the share capital of A. C. Scott and Co. Ltd., electrical resistance wire and tape manufacturers, of Wythenshawe, Manchester. Chairman and managing director of Range Boilers, Mr E. Dickinson, has been appointed chairman of Scott's but the latter's existing directors and management continue.

£2,500 damages against Eastern Board

AGREED damages of £2,500 for the death of her husband, a linesman's mate employed by the Eastern Electricity Board, were awarded in the High Court last week to Mrs W. P. Harris, of Beccles. It was stated that Mr Harris fell from an overhead line pole after receiving an electric shock, and died. Entering judgment with costs by consent against the Board, Mr Justice McNair ordered that £600 of that sum should go to two daughters.

GLASGOW ELECTRIC TRAINS WITHDRAWN

FOLLOWING an outbreak of fire last Saturday on a train on Glasgow's recently electrified suburban railway, British Railways announced that all electric stock was to be withdrawn for investigation by the makers, in this instance, AEI. The fire emanated from two electric motors on the train, and the incident resulted in a second major breakdown on the service in one week. On the previous Tuesday, a transformer blew up on a Glasgow-bound train as it was passing Renton Station. A meeting has been held between BTC officials and representatives of firms supplying 25 kV a.c. stock equipment to all Regions of British Railways. The meeting was primarily to ascertain whether the trouble experienced with AEI stock on Scottish Region was likely to be met with on other sections of 25 kV a.c. line in the country. An assurance was given to the effect that the fault was confined solely to equipment in use in Scotland.

A public inquiry is to open in Glasgow on 22 Dec. The Glasgow electrified services began on 7 Nov. last. There are 52 miles of track. At present 67 sets of coaches have been delivered, and when the service was withdrawn 17 of these were out of service because of mishap in some way.

Ferranti plans Scottish Expansion

FERRANTI LTD. plans to set up a new factory at Dalkeith, near Edinburgh. Negotiations are proceeding for the Midlothian County Council to build a factory on a 50,000 sq ft site at a cost of about £150,000 and let it to Ferranti. The factory would employ 300 men and 200 women. Ferranti's Scottish factories were "bursting at the seams," a company representative told the ELECTRICAL TIMES recently. The pressure on space is such that Ferranti is at present concluding a bargain under which they would occupy the Corn Exchange in Dalkeith until the new factory was ready.

The group's manufacturing in Scotland is in two main groups—computers and control equipment for machine tools, and "Airpass" (Airborne interception radar and pilot's attack), which is being produced for English Electric's P1B Lightning. The machine tool control equipment is understood to be selling well, and exports to the US are at a high level.

GLASS TUBING EXPANSION

THE expansion of the Chesterfield glass works, to which we briefly referred last week, is part of a £1 million scheme to be completed in three years, when the tubing plant will have trebled its present capacity. The decision to expand follows last week's announcement of the new link of AEI and GEC in a jointly owned company to make and sell glass, by taking over the AEI Chesterfield glass works and those of GEC at Lemington-on-Tyne and Wembley.

By creating this larger and more economic unit it is hoped to withstand competition and overcome tariff barriers. Glass production at Chesterfield is continuous round-the-clock and consists of components for the electrical industry, including lamp making, and domestic glassware in about even quantities. Annual output is now 10,000,000 lb of high-grade glass tubing, ranging from 0·1 in. to 2½ in. dia, and 50,000,000 drinking glasses, in a variety of styles.

The expansion of tubing output is expected to require a further 100,000 sq ft of floor area.

Safety system given to Coal Board

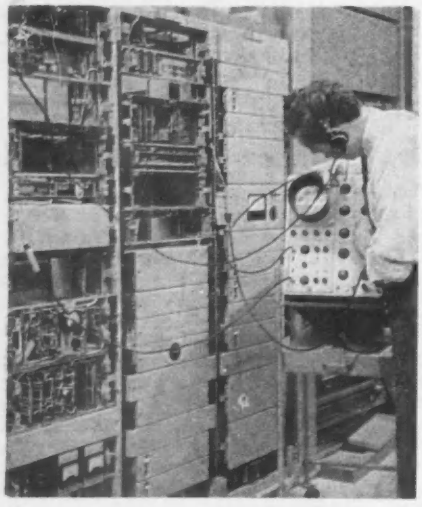
BALDWINS and Francis Ltd., Sheffield manufacturers of electrical equipment for the mining industry, have given the National Coal Board a licence to use their patents on earth leakage protection, free of charge. This gesture was made in the interests of safety, even though the NCB uses the system extensively to reduce the danger of gas exploding in the event of an earth fault, and was willing to go on paying for the privilege. The agreement will save the NCB anything up to £80,000 a year.

400 kV LINE

IN our recent report of the CEGB decision to introduce a 400 kV system, it was stated that the first line at this voltage was expected to come into commercial operation in 1962. This is incorrect; 1965 is the expected date. This line is likely to be a two-conductor bundle line. The first four-conductor bundle 400 kV line will be brought into use at a later date.

New Telephone System Trials in Madrid

A NEW telephone transmission system, using pulse-code-modulation techniques, is now undergoing extensive field trials on a working cable link in Madrid, Spain. The system has been developed by engineers of Standard Telecommunication Laboratories Ltd. in conjunction with Standard Telephones and Cables Ltd. and Le Materiel Telephonique, of Paris. It offers a tenfold increase in the number of telephone circuits possible over junction cables in towns and cities. The system was invented over 20 years ago, but is not in widespread use, being generally considered only for specialised services.



For the purpose of the tests, two Madrid telephone exchanges, Norte and Delicias, are linked by PCM equipment over an existing 6 km length of cable. The cable contains 900 pairs of wires, of which a small number are given over to PCM transmission.

CONTRACTOR OBJECTS TO APPRENTICESHIP COMPULSION

ALTHOUGH an electrical contractor may employ an apprentice electrician and observe all the terms and conditions of employment laid down in the National Agreements and Working Rules, he is not bound to register the apprentice under the present interim system. That is the basis of an award by the Industrial Court last week. The electrical contractor, T. Cowie, of Salisbury, is not a member of the National Federated Electrical Association. It was claimed by the Electrical Trades Union that he was not observing the appropriate terms agreed by the NJIC by refusing to register the apprentice. The non-registration of the employee was the only complaint the ETU had against the employer.

The apprentice was, in fact, being paid above the agreed rate of pay and enjoying a better standard of conditions than that laid down in the Agreement, the employers submitted. The Court found for the employer.

Mr T. Cowie told the ELECTRICAL TIMES last Friday that it was compulsion to which he objected. Now that he had won the dispute and was free to decide, he would register the apprentice.

OFFICIAL PUBLICATIONS

BS 3228. Procedures for Obtaining Properties of Steel at Elevated Temperatures. Part 3. Creep Strength. 3s.

Memorandum on the Post Office Bill. HMSO. 9d.

Research and Development Requirements of the Shipbuilding and Marine Engineering Industries. DSIR Report. HMSO. 1s 6d (see page 974).

Home Safety Bill. HMSO. 3d (see page 975).

C.E.R.N. Reorganised

REORGANISATION of the European Organisation for Nuclear Research (CERN) into 12 divisions, instead of the six previously existing, was announced recently by the Organisation's council. This decision recognises the fact that CERN has passed from the stage of construction to that of actual fundamental research, officials have stated. Equipment at the Geneva headquarters includes the 28,000 MeV proton-synchrotron and a 600 MeV synchro-cyclotron. In 1961, the organisation is budgeting to spend 67·7 million Swiss francs (£5·6 million). An important item in expenditure is the large amount of electric energy necessary to operate the high voltage accelerators.

Research at Imperial College

PROGRESS with research in the electrical engineering department, Imperial College, University of London, is given in the recently published annual report for 1959-60. Much attention is being given to electrical machines in terms of their electro-magnetic properties.

It has been shown that forces which act on iron parts of a complex shape in a magnetic field can be calculated more easily than had previously been supposed; and the fields set up by end-windings in a machine are also amenable to calculation.

Mathematical techniques are being applied to investigating improvement in steady-state stability of power systems made possible by modern types of automatic voltage regulator, and experimental work on other control problems is being carried out with the aid of the department's model power system (microreseau).

Other work in the department includes a study of control problems involving many interacting variables which are encountered in any industrial process, such as oil refining. The problem is to permit automatic setting of all variables so as to maximise some performance index. Work has been revived on gas discharges and plasma in view of possible applications in the electricity generation field. Attention is being given to the study of plasma phenomena when plasma are built up from ions with high initial energy. The method is said to hold promise of being less subject to instabilities than methods in which the plasma is first formed and then heated.

The report also notes much activity in the field of telecommunications and some concerning electrical materials.

"TRYDAN"

MAKING its somewhat belated appearance, the first magazine of the South Wales Electricity Board, just published, is brightly produced under the name *Trydan*—the Welsh word for electricity. In addition to covering a wide range of activities of the Board and its employees, this first issue includes a special stop press report on the floods in South Wales, to which we referred last week. It compares well with the magazines of other area boards.

Vactric allegations

ALLEGATIONS that operations on the Stock Exchange involving hundreds of thousands of Vactric shares, played an important part in contributing to the company's trouble, were made by Mr A. E. Cooper, MP for Ilford South, in the House of Commons last week. He asked the President of the Board of Trade to institute a public inquiry into share dealings "with particular respect to put options and short selling." For the Board of Trade it was indicated that the company being in the hands of the Official Receiver, made action difficult, but they asked for further information.

COALFIELD DRILLING IN EIRE

DRILLING is now being carried out in the Arigna coalfield, Eire, with a view to ascertaining the size and workability of deposits of "crow" or low-grade coal there, Mr E. Childers, Minister for Transport and Power, told members of the Irish Mining and Quarrying Society recently. It was hoped that, as a result of the investigations, economically workable deposits of coal of sufficient quality and quantity to supply a second generating station would be located. Cost of the drilling is being met by the US Grant Counterpart Fund.

Chloride Ltd. shifts sales headquarters

CHLORIDE Batteries Ltd. are shifting their sales headquarters from London to their head office at Exide Wks, Manchester. The new arrangement, which will take effect from 2 Jan., is being made to achieve closer co-ordination with technical and production departments. London sales office will continue to handle, in particular, Government business, automotive equipment and dry batteries and, at the end of January, will move from Grosvenor Gdns Hse to 137 Victoria St, S.W.1.

Transformer Developments

THE article, "Transformer Developments," published in ELECTRICAL TIMES, 8 Dec., 1960, referred to noise attenuation up to 35 dB by steel enclosures. We have been asked by Ferranti to point out that this should be 25 dB.

MORE FILMS FROM E.D.A.

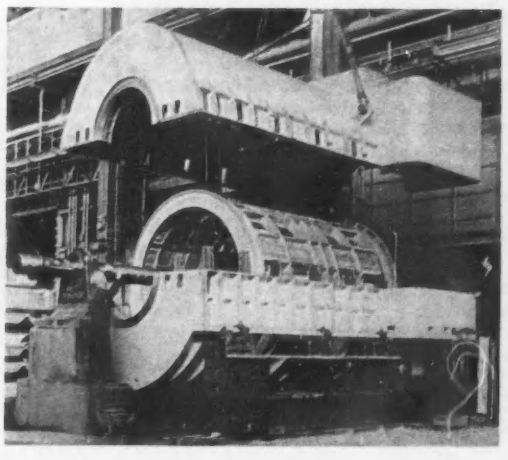
THE latest documentary films produced for EDA deal with domestic cooking and refrigeration. Intended for showing in schools and domestic science colleges, they represent the two sides of EDA's policy of separating the "educational" from the "promotional."

In the former category are "The Modern Refrigerator" and "The Modern Electric Cooker." The first of these, lasting about 25 min, is in two parts and explains the chemistry of decay and the steps which can be taken to prevent it through refrigeration. This film deals with the compressor type refrigerator in detail, reducing the technicalities to simple images which can be readily understood. The cooker film, running for some 16 min, also makes good use of animated diagrams to show the workings and advantages of electric cooking.

The "promotional" type of film, on domestic electricity, is directed at breaking down the prejudices of older and more experienced housewives. "Time to Come," a 25 min colour film, shows how a grandmother living alone is reluctantly converted to electric cooking, and subtlely suggests that she has been given back something of the social prestige which had otherwise gone from her. This film has originality in direction and script, and is convincingly performed by well-known actresses. All the films are excellent documentaries by any standard and achieve their ends without arousing the irritation so often associated with "promotional" techniques.

Export thrust at Latin America

SCOPE of the Dollar Exports Council has been widened to cover the Caribbean and South America, and the organisation has been renamed the Western Hemisphere Export Council. Announcing this in London last week, Lord Rootes, said dollar markets were as vital os ever, but the need was for more exports overall.



Lifting the top half of a 200 MW alternator stator shell after machining the bore of the inner stator casing at GEC's Witton Works. Two of these turbo-generators are being supplied for the Kincardine "B" power station of the South of Scotland EB. In order to reduce to a minimum the transmission of vibrations from the inner stator casing to the foundations upon which the machine will be mounted, this casing is fixed to the outer shell by means of four axially-placed leaf-type springs

Electrical Firms Important in Shipbuilding

PUBLICATION last week of the much-leaked report of DSIR investigations into research and development requirements in the British shipbuilding and marine engineering industries emphasises the importance of some large electrical firms to those industries in terms of propulsion equipment. The report is generally critical of the research and development effort of the industry.

The report comments that R and D work in regard to marine propulsion installations is handicapped by the organisational structure of the industries producing propulsion units and auxiliaries.

Today, ship propulsion is either by steam turbine or diesel. So far as diesel engines are concerned, there is only one independent British designer for the large units (over 5,000 h.p.) although others manufacture under licence. The report says that continental designers have led the way in this field, where they are large-scale producers supporting relatively large research and development teams in contrast to relatively small British firms.

Marine turbines for merchant ships are made in the UK by 17 firms plus AEI. All except AEI are members of the Parsons and Marine Engineering Turbine Research and Development Association (of which, in fact, C. A. Parsons ceased to be members in 1951). The report notes that large electrical industry turbine manufacturing groups are not members of the Association. When EE Co. applied for membership in 1947 their application was rejected. In 1957, the Association suggested to EE Co., AEI, C. A. Parsons and GEC, together with General Electric and Westinghouse of America, an arrangement for interchange of information and test facilities, but these offers were declined.

The DSIR committee found conflicting evidence as to whether British marine turbine designs were as good as foreign turbines or not. Some critics considered that firms like AEI and EE Co. should be encouraged to enter the marine field so that the benefits of their "very considerable research and development" could be available to counter foreign competition.

L.D. nuclear order

AN order for nearly 400 permanent-magnet motors, for operating the reactor control rods of the Trawsfynydd nuclear power station, has been placed with Lancashire Dynamo and Crypto Ltd.

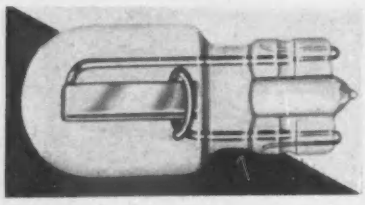
Class "H" insulated to operate in an ambient temperature of approximately 100°C, the motors will be operated from a variable frequency supply so as to have a final speed of between 0·2 r.p.m. and 0·7 r.p.m.

E.A.W. Conference

The annual conference of the Electrical Association for Women is to be held in London on 1 and 2 May, 1961. There will be an evening reception at Goldsmith's Hall on 1 May, and the a.g.m. at Kingsway Hall on 2 May will be followed by luncheon at the Connaught Rooms.

Miniature all-glass starter switch

WHAT is believed to be the first miniature all-glass capless starter switch in the world has been developed at the Leicester headquarters of the AEI Lamp and Lighting Co. Ltd. Its use is expected to be principally in association with tubular fluorescent lamps and fittings. Similar in appearance to the new Mazda all-glass capless lamps, the new switch has the same robust preformed glass base. Its glass bulb is only ¼ in. in diameter yet it is designed to operate all wattages of fluorescent lamps up to and including 80 W, to the performance standards required by BS 2818, Pt. 3. Patents have already been applied for this switch, which lends itself to wide use with simple and compact forms of socket.



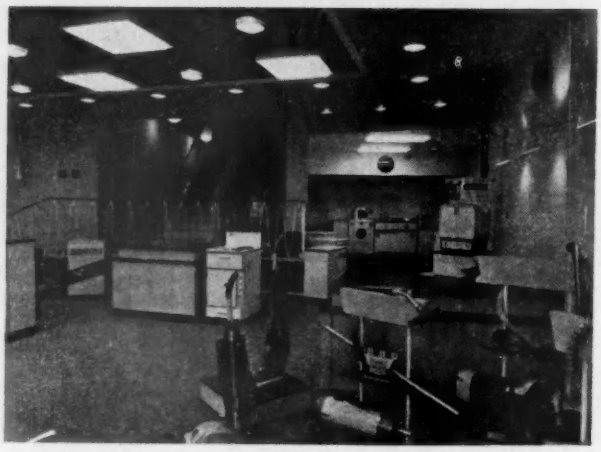
The switch, twice actual size

TWO NEW SERVICE CENTRES

NEW premises were opened by two area boards during the past week. S Wales EB's plans for new headquarters for Carmarthenshire district were fulfilled and MEB opened a new showroom at Shard End Crescent in the south east district of Birmingham.

Building of SWEB's new district h.q. began on a corner site in Carmarthen's main shopping centre a year ago. After being divided in two of the oldest buildings in the town, district headquarters and showroom are now housed in a contemporary two-storey building. Passers-by can see the whole of the showroom through the open glass front and glass swing doors, as the 900 sq ft area is lit with 6·6 kW, made up of a composite tungsten and fluorescent centre panel supplemented by wall brackets. Adjacent to the showroom are a demonstration area, with modern kitchen layout, and a room for interviewing customers. The whole building is heated by 80 kW of off-peak floor-warming. An infra-red heating system will be installed in the cantilever canopy above the pavement early next year. The front of the building is trimmed with Westmorland slate and the side is Tyrolean rendered.

The showroom at Carmarthen is shown in the bottom picture. The top picture shows Northfield centre, which opened in the south west district of Birmingham recently.



Top: A feature of the showroom at Northfield, Birmingham, is a luminous ceiling, supplied by Courtney, Pope (Electrical) Ltd. Made up of specially designed 3 ft sq translucent panels, this section is lit by 8 ft 125 W lamps.

Right: The contemporary style of Carmarthen's showroom

WOMAN'S H.P. COUP

LITTLE wonder that hire-purchase chickens are coming home to roost. A Liverpool housewife, who has admitted selling £12,000 worth of goods held on hire-purchase, said she obtained "at least four dozen washing machines, a dozen fridges, a dozen televisions, a dozen radios, a dozen spin dryers" and a host of other articles from 26 stores by the simple ruse of using false names. Judge Laski said in Liverpool Crown Court that such cases made him think hire-purchase laws should be tightened up. She was also selling and taking advance rent on the house she lived in but did not own, and was sent to prison for four years.

A.S.E.E. Ladies' Evening

SOME seriousness was imparted to the annual Ladies' Evening of the Association of Supervising Electrical Engineers this year, by a stirring appeal for more effort in exporting, delivered in the witty speech by the guest of honour, Miss Patricia Hornsby-Smith, M.P. But that was a momentary break in an evening that was as lighthearted and successful a pre-Christmas party as ever. Miss Hornsby-Smith was replying to the toast of the evening, proposed by ASEE chairman, Mr G. C. Kitchener. She said at no time had Britain needed skilled and highly trained men and women as at present; and at no time had she faced such competition from abroad. None of the big national schemes for roads and railways would be worth the paper they were written on unless export trade was successful.

HOME SAFETY

THE main provisions of a new Home Safety Bill presented in the House of Commons recently is to enable certain local authorities in England and Wales to promote safety in the home and to make contributions to voluntary organisations whose activities consist of or include the promotion of safety in the home.

Sayings OF THE WEEK

"The design of power distribution networks is still more of an art than a science." . . . MR G. S. BUCKINGHAM, in his IEE paper on "Short-Circuit Ratings for Mains Cables."

"Never let your husbands know you can mend a fuse. If you do, you will find yourself rewiring the house and your husband won't even be around to hold the pliers." . . . MRS B. J. FINNIE, at silver jubilee luncheon of West Kent branch, EAW.

"The construction of power stations in the Midlands is not universally welcomed." . . . From a CEGB statement on proposed sites for nuclear stations on the South Coast.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Monday, December 19

	£ per ton	Weekly change £
COPPER, standard class A (settlement) ...	236½	+2½
" (3 months)	234½	+4½
LEAD, refined pig, 99·97% purity (cash)	64	−2
" (3 months)	65	−2
TIN, refined, min. 99·75% purity (settlement)	796½	−1
" (3 months)	794	−1½
ALUMINIUM, ingots 99·99·5% ...	186	—
" wire bars (4 × 4 × 54")	193½	—
BRASS Strip 63/37	202½	−4½
SILVER (Troy oz)	79½d	—

	£ per ton	Weekly change £
ZINC, virgin, min. 98% purity (cash)	80⅜	−3½
" (3 months)	81	−3
RUBBER, per lb		
No. 1, RSS, spot	25½d	−⅛d
c.i.f. basis, ports, Feb. ...	25½d	—
ARMOURING:		
Galv. Steel Wire (0·104 in.) ...	68	—
Mild Steel Tape (0·04 × 1½ in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	69½	−1
AMERICAN PRICES:		
Copper, electrolytic (per lb) ...	30c	—
Lead, (New York)	11c	−1c

* *Tape Price, now an average, includes varnishing*

Annual check on washing machines urged

A BROKEN earth wire and the rough head of a screw were reasons for an electric washing machine becoming live, killing a 31-year-old housewife, it was stated at an inquest at Abercynon, Glam, last week. After hearing evidence, the Coroner agreed with an official of the South Wales Electricity Board, that washing machines should be checked annually to make sure the machine and installation were in perfect order.

The washing machine, which had been purchased five or six years ago, had not given any trouble, apart from the earth wire which was attached to a clip on the water pipe of the kitchen tap. Husband of the deceased, Mr Watts, said the earth wire broke about a foot from the clip and he joined it up several times, for it always seemed to be breaking. He did not realise the significance of the earth wire.

Mr H. S. Vaughan, of the South Wales EB, said it was found that one of the live leads connecting the coils inside the motor had chafed, cutting through the insulation and touching the frame of the machine. A screw in the motor had a rough edge and, when the machine was in operation, the vibration would chafe the insulation. There was no earth connection.

A verdict of accidental death was returned.

380 at Xmas luncheon

DESPITE his early electrical engineering exploits, electricity was here to stay, Mr Norman Collins, well-known author and deputy chairman of Associated Television, said as guest speaker at the Electrical Industries Club's Christmas luncheon in London last week. The principal exploit was blacking out a village when replacing a fuse. A record 380 members and guests attended the luncheon. A collection for older Electrical Industries Benevolent Association beneficiaries realised over £130.

O.E.E.C. SUCCESSOR AGREED

FORMAL signing in Paris last week of the charter of the new Organisation for Economic Co-operation and Development (OECD) marks an important stage in the development of a successor to the 12-year-old OEEC. The new Organisation will have USA and Canada as full members, besides 18 European countries, and will have wider scope than its predecessor.

Much of the committee structure of OEEC is to be retained by the new body. However, it will add to this machinery a trade committee which will make regular examinations of general trading policies of member states.

News in Brief

Annual luncheon of the British Refrigeration Association will be held at Connaught Rooms, W.C.2, on 10 March. The Rt Hon F. J. Erroll, President of the Board of Trade, has accepted an invitation to attend.

On 1 Jan. Spain will become the fourteenth member State of CERN, the European Organisation for Nuclear Research.

The Royal National Lifeboat Institution has decided to fit Aqualite L20 automatic lights to all life-jackets used in the service. These have a silver chloride-magnesium 1½ V battery encased in plastics, the lights being automatically activated in water.

Annual general meeting of the North Metropolitan branch of the EIBA will be held at Northmet Hse, Southgate, N.14, on 9 Feb., at 3 p.m.

Dimplex Ltd. are to launch a large advertising and sales promotion campaign for their towel rails next February.

Barclays Bank is soon to take delivery of their first automatic cheque-sorting machine.

With falling sales of TV sets, the General Electric Co. is taking 140 women workers off the TV lines at its Coventry factory.

Company Activities

PERHAPS it was the thought of Christmas which at one time last week brought a little more cheer into stock markets, since certainly there was nothing in the latest trade figures and balance of payments to cause much rejoicing. None the less, over the week a gentle leavening of prices was seen to extend to the electrical share market.

It is true that the "trade gap" declined to £70 million in November from £122 million in October, but both the record export figure of £342 million and the record level of imports at £420 million were distorted as a result of the tally clerks' strike in October which then put a brake more on exports than on imports. So, if exports are taken over the three months September/November they emerge only 2% up on the previous three months, while on a similar comparison imports edged up 3½%. Further, compared with a visible trade deficit of £41 million in the third quarter of 1959 there was a deficit of £133 million in July/September, 1960. And when we look at the overall current balance of payments, which counts in earnings on "invisibles" for services rendered, etc., it is found that there was still a £101 million deficit in the third quarter of 1960 against a £43 million surplus a year before. In fact, over the first nine months of 1960 the deficit had added up to £66 million against a nine months' surplus of £159 million in 1959. Those, therefore, who have been looking for some ease in the "squeeze" will have to keep looking for some time, since until there is a marked improvement in our external earnings there just can be no let-up on the present domestic curbs.

But certainly the electrical market fared fractionally better. Thus, AEI crept up from 39s 6d to a wary 41s 3d, BICC gained 4½d at 48s 6d, E. K. Cole went 1s dearer to 19s 7½d and Elliott-Automation scored a 1s 3d gain at 24s 1½d. After the previous week's falls both Ultra Electric and Radio and Allied Holdings made good recoveries. There were also a number of responses to specific items of company news and among the most outstanding was the 3s rise in the 10s Ordinary shares of the Plessey Co. to 47s. News from them was that their subsidiary, Garrard Engineering and Manufacturing, has secured gramophone equipment orders from the United States valued at $1 million for delivery within the first three months of 1961. Plessey shares, now 7s below their 1960 "high" and yielding 3·6%, could easily prove a "winner" in 1961. As a guest recently in a Parisian household, I was also told that Garrard 'gram equipment is very much sought after in France. *Verb. sap!* Initially, International Computers and Tabulators also responded well to their trading results for the year and the 1¼ point increase in the total dividend to 11¼%. The net profit after tax is up from £1,304,000 to £1,926,000. So after starting out the week at 59s the £1 Ordinary shares, after dipping to 58s 9d, climbed to 63s 6d after the results but came back to finish business at 58s 9d.

But two of the top spots were supplied by Decca Record and EMI, whose shares spun up 3s 6d and 1s 9d to 52s and 43s 9d, respectively, on the industry's record disc sales before coming back to 51s and 42s 3d. Consumer spending this year is likely to be around £30 million —its highest ever. It might also usefully go on record for ELECTRICAL TIMES readers that EMI shares, now 28% below their top price touched earlier this year, will prove among those to star in any electrical "Hit Parade" 1961 cares to arrange.—*From our City Correspondent.*

Broom and Wade Ltd.

In addition to achieving record sales and profits in the year to 30 Sept. last, this company's order book at the present time is higher than at the same period last year, Mr H. S. Broom, the chairman, reports. Chief reason for the company's greater profitability is higher turnover, accomplished by more efficient production, he adds. Capital commitments at the end of the year were estimated at £200,000, and a comprehensive scheme for the progressive replacement of all plant is under review.

Dewhurst and Partner

After all charges, including taxation, profit for the year to 30 Sept. last amounts to £124,256 (*£117,390*), and a final dividend of 15% again makes the total distribution 20%. Taxation charge this time is £119,397, compared with £76,616 allowed in the previous year.

Kenwood Manufacturing Co.

Announcing an interim dividend of 7½% for the year ending 31 July next the directors state that the group profit, before tax, for the 19 months' period to 31 July, 1960 (including results of Kenwood Manufacturing (Woking) Group for a year) amounts to £42.675. Of that sum, taxation absorbs £33.282 leaving a group net profit of £9.393. When the companies were amalgamated in December, 1959, a profit of £196.000 was estimated for the period, but since then production difficulties, particularly with the mixer, have caused a decline in profits. Those difficulties have now been largely overcome and the outlook for the current year is more encouraging. Although sales of some products (such as refrigerators) have been affected by the credit squeeze, sales of the new Chef mixer are stated to be higher than the peak levels reached in 1959.

Lloyd's Packing Warehouses (Holdings)

This group (which took over Long and Crawford last March and includes Regentone Products Ltd.) is paying a final dividend of 9%, making a total of 15% (*same*). Group net profit declined to £233,435 (*£287,303*) after taxation charge of £154,766 (*£274,207*).

Radio Rentals Ltd.

With group trading profit for the year ended 31 Aug. last increasing to £5,742,065 (from £4,917,999 in the previous year) the total dividend is also effectively raised 5%. Final dividend is 15% making a total of 20% on capital increased by a one-for-two scrip issue. Depreciation absorbs £3,439,954 (*£2,968,104*) this time, but taxation is £123,155 down at £728.124, leaving a net profit of £1,573,987 (*£1,098,616*).

Spark Holdings Ltd.

This group now has nine operating subsidiaries, with Hawke Cable Glands Ltd. and Ductwork Ltd. among the four firms in the Engineering Division. Six of the subsidiaries were acquired in the past year and Mr J. G. Lawson, chairman, has told shareholders that the expansion of the group has been financed almost entirely out of its own internal resources and even now the overall indebtedness to bankers is less than £50,000. The board propose to bring the issued capital into line with the real capital employed and as a first step suggest the writing up of the issued share capital from 1s to 2s/share, i.e., a total of £183,750. As the group nominal capital is only £300,000, this will be raised to £1 million to permit not only future capitalisations, but also to give a reserve of unissued capital for any new acquisitions

Thorn Electrical Industries

Dealing commenced earlier this week in the £3 million newly created 6½% Unsecured Loan Stock, 1985-89. The stock was placed by Hambros Bank, with a proportion available in the market, consisting of £600,000 at £98½%. Net proceeds of the issue will be used to reduce bank overdrafts which amounted to £2,974,793 on 3 Dec. Over the past five years net profits have averaged £1,655,709 before taxation.

Dividends Declared

Cables Investment Trust. Interim 10d per share (*same*).

Combined Electrical Manufacturers. Interim is 4% as forecast at time of merger of Hackbridge and Hewittic Electric Co. and Switchgear and Cowans.

Globe Telegraph and Trust. Interim 2½d per share (*same*).

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

22 Dec.—Ealing B.C. Electrical installation renewal at St. Ann's Secondary Girls' School, Springfield Rd.—Advertised 1 Dec. issue.

23 Dec.—Brentwood U.D.C. Supply of (Tender 22) lamps for year.—See 15 Dec. issue.

23 Dec.—Eastleigh B.C. Supply of (Item 10) street lighting lamps for year from 1 April, 1961.—See 8 Dec. issue.

27 Dec.—Scottish National Camps Assn. Electrical installation at Belmont Camp School, Meigle, Perth. Applications to General Manager and Secretary, 57 Melville St, Edinburgh 3, by above date.

28 Dec.—Haltemprice U.D.C. Supply of lamps and tubes.—See 15 Dec. issue.

28 Dec.—Prestwich B.C. Supply and erection, on fixed-price basis, of 26 reinforced concrete columns with 24 fluorescent and two sodium lamps/gear along Rectory Rd and 27 concrete columns with sodium lighting at King's Rd, plus removal of 31 existing units.—See 15 Dec. issue.

29 Dec.—Enniskillen R.D.C. Provision of 19 fluorescent lanterns on concrete columns and eight on wood poles. Engineer and Surveyor: A. Stephenson, Council Offices, Cornagrade. Deposit £2 2s.

29 Dec.—Farnborough U.D.C. Lighting and power installations at Jubilee Hall. Engineer and Surveyor, Municipal Offices, Alexandra Rd, Farnborough, Hants. Preference to contractors on N.I.C.E.I.C. roll.

30 Dec.—Denby Dale U.D.C. Supply, erection and wiring of 225 25 ft Stanton concrete columns together with 140 W sodium lamps/lanterns/gear along A636 Wakefield Rd and A635 Barnsley Rd.—See 8 Dec. issue.

30 Dec.—Monaghan C.C. (b) Erection and installation of two pumping sets to deliver 28 g.p.m. at a 106 ft head for Rockcarry scheme. Supply and/or erection of two 42 g.p.m. pumps at a 128 ft head for Newbliss. —See 1 Dec. issue.

30 Dec.—Shoreham-by-Sea. Street lighting comprising 13 Group "A" single arm, one double arm 140 W sodium and one post-top fluorescent lantern at High St divided: (1) supply of electrical equipment; (2) taking down existing columns, supply/erection/fitting/wiring of electrical equipment, of own tender; (3) with electrical equipment by another manufacturer. Surveyor, St. Wilfred's, Ham Rd.

31 Dec.—Bacup B.C. (a) Electrical work in 29 houses at Tunstead Rd estate, Stacksteads. Borough Engineer, Municipal Offices. Deposit £2 2s.

31 Dec.—Llanfyllin R.D.C. Electrical installation in new offices.—See 8 Dec. issue.

2 Jan.—Droitwich B.C. Supply and erection of 52 street lamps, together with lanterns/gear/wiring.—Advertised 15 Dec. issue.

2 Jan.—Romford B.C. Supply of 200 W sodium lamps/lanterns/gear/brackets for conversion of 69 existing units.—See 15 Dec. issue.

2 Jan.—Romford B.C. Tender M26. Supply of lamps for year.—See 15 Dec. issue.

2 Jan.—Saundersfoot. Wiring of village hall. Details from Major E. Molyneux, Langdale, Stammers Rd, Saundersfoot.

3 Jan.—Manchester C.C. Provision of road and car park mercury vapour lighting at Manchester Airport.—See 15 Dec. issue.

3 Jan.—Radcliffe B.C. Supply and installation of 43 140 W sodium lamps on 25 ft columns and brackets, plus removal of 28 existing units along A667, Ringley Rd.—See 1 Dec. issue.

4 Jan.—Manchester C.C. Electrical services installation in Central Technical College, Manchester 15.—See 15 Dec. issue.

5 Jan.—Belfast C.C. (a) Electrical installation in Fane St Secondary School.—See 8 Dec. issue.

5 Jan.—Staines U.D.C. Fixed-price basis: Supply, fitting and erection of Class "A" steel columns with 168 mercury fluorescent and 15 fluorescent lanterns, lamps, gear and ancillary work. Engineer and Surveyor, Shortwood Hse, 240 London Rd. Deposit £2 2s.

6 Jan.—Belfast C.C. (a) Supply of condenser tubes and (b) supply and erection of 25 kW germanium diode rectifier sets (Specifications W184 and 5, respectively).—See 8 Dec. issue.

6 Jan.—Blackpool B.C. Supply of lamps for year to 31 March, 1962. Director of Lighting and Electrical Services, Rigby Rd East.

6 Jan.—Camberwell B.C. Supply of (Item k) lamps and (Item s) cables, conduit and fittings.—See 15 Dec. issue.

6 Jan.—Cardiff C.C. Erection, on fixed-price basis, of 18 30 ft metal, 20 25 ft concrete and metal and 400 Class "B" concrete columns, 180 trolley pole brackets, 35 catenary suspended lanterns and installation of 200 W and 140 W sodium and 80 W and 400 W mercury lamps/gear. City Surveyor, City Hall. Deposit £2 2s.

6 Jan.—Kilkeel. Electrical installation in Holy Cross Primary School.—See 15 Dec. issue.

6 Jan.—Wanstead and Woodford B.C. Supply of (Item 13) for year.—See 8 Dec. issue.

6 Jan.—Wood Green B.C. Supply of (Item 17) lamps.—See 15 Dec. issue.

7 Jan.—Baldock U.D.C. Supply and erection of 11 25 ft concrete columns with 140 W sodium lighting.—See 15 Dec. issue.

7 Jan.—Bath C.C. Supply of (Item 40) l.v. cables; (41) discharge lamps; (42) tungsten lamps and fittings; (43) steel and concrete columns; (44) street lighting lanterns; (45) control gear and capacitors; (46) time switches, for year.—See 8 Dec. issue.

7 Jan.—Dagenham B.C. Supply of (Item 31) lamps for year.—See 15 Dec. issue.

9 Jan.—Skipton U.D.C. Rewiring of 83 pre-war houses, Shortbank Rd. Engineer and Surveyor, Town Hall. Deposit £2 2s.

9 Jan.—Swansea B.C. Two disintegrator sets pipes, valves, control gear, switches, switchboard, etc., for Limeslade Sewerage Scheme. —See 15 Dec. issue.

9 Jan.—West Lancs R.D.C. (a) Supply of 55 Class "A" and 527 Class "B" concrete columns/brackets; (b) supply of 140 W sodium and M.F. Class "B" lamps/lanterns/transformers/capacitors; (c) erection of columns/brackets, fitting and wiring of electrical equipment and commissioning plus removal of redundant equipment. Engineer and Surveyor, Council Offices, Derby St, Ormskirk. Deposit £2 2s.—Advertised in this issue.

10 Jan.—Dunblane B.C. Supply and erection of seven Group "A" concrete columns/lanterns/auxiliary equipment, plus the resiting of six columns along A9.—See 10 Nov. issue.

10 Jan.—Hebburn U.D.C. Electrical installations in 42 houses in central area redevelopment scheme. Surveyor.

11 Jan.—Blyth. Supply of (Item 15) cables and fittings for year to 31 March, 1962. Borough Engineer, Municipal Bldgs.

11 Jan.—Tonbridge R.D.C. Wiring, by registered contractors, of Council Offices and proposed extension.—See 15 Dec. issue.

12 Jan.—Westminster C.C. Supply of lamps for year from 1 April, 1961. Applications, enclosing 14 in. by 10 in. s.a.e., to Town Clerk, City Hall, P.O. Box 141, W.C.2.

13 Jan.—Malden and Coombe B.C. Provision of Group "A" 200 W sodium and fluorescent lighting schemes with tubular steel columns. Borough Engineer and Surveyor: J. Apse, Municipal Offices, New Malden.

14 Jan.—West Lothian C.C. Supply and erection of 25 200 W long type sodium lanterns on 35 ft steel columns/brackets along A8, near Bangour Hospital. County Electrical Manager, 212 High St, Linlithgow.

16 Jan.—Bermondsey B.C. Supply of lamps for year.—See 8 Dec. issue.

16 Jan.—Birmingham Tame and Rea. Three 1,500 g.p.m., two 140 g.p.m. and three 70 g.p.m. centrifugal pumps complete with motor control gear. District Drainage Board Engineer, Rookery Park, Erdington, Birmingham 24.

16 Jan.—Prestwich B.C. Supply of (Item 10) lamps for year to 31 March, 1962. Borough Engineer, Town Hall.

17 Jan.—Newcastle upon Tyne C.C. Supply and installation of two automatic passenger lifts in each of two 15-storey blocks of flats at Longbenton Estate.—See 8 Dec. issue.

28 Jan.—Camborne-Redruth U.D.C. Supply of (Item 24) electrical equipment and fittings for year.—See 8 Dec. issue.

28 Jan.—Rhyl U.D.C. Supply and installation complete of: (a) two 1,560 g.p.m. sewage pumps, two 8,250 g.p.m. and two 12,450 g.p.m. storm water pumps with

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 110 queries answered this week

"Westminster" electric blankets—address for? C.C.—Norrand Ltd., 62 Clayton La, Bradford 5.

Easy Washer Co., of Toronto—agents for? S.E.E.B.—Metalcraft Mnfg. Co. (Canada) Ltd., 37 Berners St, W.1.

"Silent Giant" hairclippers—makers of? E.E.B.—Wahl (England) Ltd., 215 Putney Bridge Rd, S.W.15.

"Kerson" switches—address for? T.E. —Midland Electric Mnfg. Co. Ltd., Reddings La, Tyseley, Birmingham 11.

"SnoWhite" clothes driers—makers of? E.W.—J. Glover and Sons Ltd., Groton Rd, Earlsfield, S.W.18.

"Planet" lampshades—makers of? D.W. —Planet Shades Ltd., 14a Manor Rd, N.16.

"Dorset" refrigerators—makers of? L.E.B.—Dorset Refrigeration Ltd., Lake Rd, Hamworthy, Poole, Dorset.

"Ismet" fan heaters—suppliers of? E.S.—Wynebourne Electrical Products Ltd., 90-96 City Rd, E.C.1.

"Minibar" trunking systems—makers of? A. and P.—Bill Switchgear Ltd., Aston La, Perry Barr, Birmingham 20.

ANSWER WANTED

"Rotostat" starter gear—makers of? T.B.—

motors, starters, pipework, valves, etc.; (b) one 800 b.h.p. stand-by diesel-alternator (alternatively, supply only of diesel-alternator). Engineer and Surveyor, Council Offices. Deposit (a) £5 and (b) £3.

1 Feb.—Oxford T.C. Supply and erection of two high-lift 3,500 g.p.m. and two low-lift 3,850 g.p.m. pumps complete with motors, switchgear and cabling.—See 10 Nov. issue.

No date stated.—Loch Lee Water Board. Supply and installation of switchboards, wiring, lighting and heating installations for first phase Loch Lee scheme.—See 15 Dec. issue.

No date stated—North of Scotland H.E.B. Supply and erection of 132 kV steel tower double circuit spur line to Burghmuir.—Advertised 8 Dec. issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

28 Dec.—America. 500 kV, l.t. substation, duplex control centre, distribution board, battery chargers, etc. District Engineer, U.S. Army Engineer District, 628 Pittock Block, Portland 5, Oregon. B.o.T. (ESB/31999/60).*

28 Dec.—Burma. 1,470 rolls (25 yd) 2 in. wide black adhesive insulating tape. Director-General, Union of Burma Purchase Board, St. John's Rd, Rangoon. B.o.T. (ESB/32471/60).*

28 Dec.—Burma. One gross 24 V 15 W s.b.c. lamps, 30 gross 110 V 60 W b.c. lamps, 60 gross 230 V 75 W b.c. lamps. Director-General, Union of Burma Purchase Board, St. John's Rd, Rangoon. B.o.T. (ESB/32475/60).*

30 Dec.—Burma. Accessories, lighting fittings, fans, switchgear, switch and distribution boards for new Intermediate College Project, Thamaing. Documents, fee £3 15s 9d, from Burmese Embassy, 76 Cadogan Sq, S.W.1. B.o.T. (ESB/32421/60/ICA).*

5 Jan.—America. Two 83,333 kVA, 13·8 kV, 225 r.p.m. vertical shaft hydraulic alternators for Spring Creek Plant. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center. B.o.T. (ESB/31977/60).*

9 Jan.—India. 24 testing instruments. Chief Engineer (South), Stores Purchase Section, The Mall, Patiala. B.o.T. (ESB/31908/60).*

13 Jan.—India. Enquiry SE 279. Cooling towers for D.V.C. Chandrapura Thermal Power Station. Documents, fee £1 1s 5d, from Co-ordination Branch, India Store Dept., Bromyard Ave, W.3, viewing reference S.3844/60/NSC/ENG.2.

13 Jan.—S. Africa. 10 MVA transformers and gear for Springs T.C. Consulting engineer: J. S. Clinton, P.O. Box 4648, Johannesburg. B.o.T. (ESB/31961/60).*

15 Jan.—Burma. Five-ton o/h travelling crane for foundry duty. Deputy Assistant Director-General, Procurement Branch, Ind. Development Corpn., 243-251 36th St, Rangoon. B.o.T. (ESB/32365/60).*

15 Jan.—Kuwait. (1) Three 5 MVA 33/11·5 kV oil immersed natural cooled transformers and (2) 500 yd 11 kV 0·4 sq in. single-core p.i.l.c.s. cable. Dept. of Electricity, Water and Gas. B.o.T. (ESB/31813/60).*

21 Jan.—Iran. 25 kW diesel generators. Imperial Iranian Navy, Tehran. B.o.T. (ESB/32310/60).*

25 Jan.—India. Switchgear for Kiriburu substation, etc. Director-General of Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (ESB/29421/60).*

26 Jan.—New Zealand. 750 rubber cased torches. Director-General (Stores Division), G.P.O., Wellington. B.o.T. (ESB/31992/60).*

9 Feb.—Australia. 1 to 10, 11 to 20 1·5 kVA s.-ph., 1 to 5 6 kVA s.-ph. and 1 to 5 6 kVA 3-ph. diesel alternators. Controller, Stores and Contracts, Postmaster-General's Dept., 114 Russell St, Melbourne C.1. B.o.T. (ESB/32482/60).*

14 Feb.—New Zealand. Four s.-ph. 3·333 MVA outdoor oil immersed transformers, alternatively two 3-ph. 10 MVA transformers. Secretary, Tenders Committee, New Zealand Electricity Dept., Wellington. B.o.T. (ESB/31439/60).*

16 Feb.—Australia. Electron tubes, 132 items. Controller, Stores and Contracts, Postmaster-General's Dept., 114 Russell St, Melbourne C.1. B.o.T. (ESB/32356/60).*

27 Feb.—India. Winding machines, ovens, impregnating plant, brazing and soldering machines. Shri D. P. Guzdar, Officer on Special Duty, Heavy Electricals Ltd., Crown Hse, Aldwych, W.C.2. B.o.T. (ESB/31972/60/).*

28 Feb.—Argentina. 150 double-bogie trams (new or second-hand). Transportes de Buenos Aires, Seccion Licitiones, Bme. Mitre 3345, Buenos Aires. B.o.T. (ESB/32324/60).*

CONTRACTS PLACED

C.E.G.B. Contracts placed during the past month amounting to £13,400,000 include: Blyth B power station: two 350 MW turbo-generators, feed water heating plants, boiler feed pumps and auxiliaries, English Electric Co. Ltd.; 415 V switchgear, contactors and accessories, M. and C. Switchgear Ltd. Thorpe Marsh power station: high pressure pipework and valves for No. 1 generator and No. 1 boiler, Aiton and Co. Ltd. Rugeley power station: auxiliary control and instrument cables and accessories, N. G. Bailey and Co. Ltd. Hams Hall A power station: 15 MW Olympus powered gas turbine generating plant, Bristol Siddeley Engines Ltd. Drakelow C power station: main foundations, J. L. Kier and Co. Ltd.; circulating water pumps, Drysdale and Co. Ltd.; circulating water valves for sets 9 and 10, Guest and Chrimes Ltd.; circulating water valves, J. Blakeborough and Sons Ltd.; coal handling plant, International Combustion Products Ltd.; high pressure pipework and valves for units 9 and 10, Babcock and Wilcox Ltd. Staythorpe B power station: No. 2 cooling tower, Davenport Engineering Co. Ltd. West Thurrock power station: generator transformers Nos. 3 and 4, Associated Electrical Industries Ltd.; reinforced concrete coal reclaim bunkers, Bierrum and Partners Ltd.; mobile coal handling plant for units 1 and 2, John Blackwood Hodge and Co. Ltd. Bankside power station: flue gas-washing plant, Head Wrightson Processes Ltd. Paddington substation: two 66/22 kV, 45 MVA transformers, Ferranti Ltd. Brimsdown substation: 33 kV switchgear modifications, Associated Electrical Industries Ltd. Carrington substation: 132 kV air blast switchgear, Associated Electrical Industries Ltd. Lancaster substation: two 132/33 kV, 45 MVA transformers and auxiliaries, C. A. Parsons and Co. Ltd. Corby substation: 275 kV switchgear, Associated Electrical Industries Ltd.: 132 kV switchgear, General Electric Co. Ltd. Taunton substation: 132 kV switchgear, Associated Electrical Industries Ltd. Skelton Grange B power station: 132 kV switchgear, Associated Electrical Industries Ltd. Whitson substation: 33 kV switchgear, A. Reyrolle and Co. Ltd. Harker-Penwortham: second circuit 275 kV overhead line, Watshams Ltd. Sundon substation: 132 kV cables, Pirelli-General Cable Works Ltd.

TRADE NOTES

Changes of Address. The Sales Departments of G. A. Harvey and Co. (London) Ltd. are now operating from Villiers Hse, Strand, W.C.2. Telephone: Whitehall 9931. Early in the new year the company will open a London showroom in the new building.

The London office of Matthew Hall and Co. Ltd. is now at 101-108 Tottenham Court Rd, W.1. Telephone: Museum 3676. The factory and stores remain at 1-4 Amberley Rd, W.9.

New Depots. Davis and Timmins Ltd. have established a new depot on the Bridgend Trading Estate.

The new Norwood Rd, Birmingham, depot of Oldham and Son Ltd. was officially opened last week.

Change of Name. The title of the Radio Rentals' subsidiary, Mains Radio Gramophones Ltd., has been changed to Baird Television Ltd.

New Telephone No. The telephone no. of the Leicester sales office of Brook Motors Ltd. is now Leicester 50781.

Agent. Armourduct Trading Co. Ltd., 1-3 Brixton Rd, S.W.9, have been appointed London agents to Swifts of Scarborough Ltd. for their cable trunking and components and cable trays.

Agreement. Marconi Instruments Ltd., under a recent agreement with Computer-Measurements Co., of Sylmar, California, will manufacture CMC's range of transistorised electronic counters, and have world selling rights outside North America and Japan.

Expansion. H. W. Field and Son Ltd. have purchased the former T.A. Drill Hall at Southwold to utilise as a branch factory.

BEAMA Contract Price Adjustment Formulae. *For Electrical Machinery and Equipment.* For purposes of calculating variations in (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Dec., 1960, shall be deemed to be 204s 6d; (*b*) "Cost of Material"—the index figure for materials used in the Electrical Machinery Industry at 16 Dec., 1960, is 116·4* (180·6*).

For Turbo-Generating and Allied Plant. For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Dec., 1960, shall be deemed to be 204s 6d; (*b*) "Cost of Material"—the index figure for materials used in the Mechanical Engineering Industry at 16 Dec., 1960, is 126·0* (189·3*). "Blast Furnaces and Iron and Steel Melting and Rolling (1948 S.I.C. ref. 40/41)," 189·5*. Other Steel Goods, excluding tubes (1958 S.I.C. ref. 311/2), 129·1*. The price of brass condenser tubes ½ in. o/d 18 s.w.g. on 16 Dec., 1960, is 4s per lb. *Provisional figure.

The figures in parentheses shown above relate to earliest list of wholesale price index numbers in which the year 1949 is taken as the base 100. For the other figures 1954=100.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Homelight. 804,181. Class 7. Machines for domestic use. Pye Ltd., Radio Wks, Cambridge.

Invalift. 807,850. Class 7. Apparatus for lifting and carrying invalids. Electrical Productions (Leeds) Ltd., Hope Rd, Mabgate, Leeds 9.

Memopark. 798,031. Class 9. Time switches, meters, etc. Venner Ltd., Kingston By-pass, New Malden.

Metrac. 803,777. Class 9. Testing or measuring instruments. Everett Edgcumbe and Co. Ltd., Colindale Wks, N.W.9.

Novotherm. 804,826. Class 9. Instruments, etc. Thermocontrol Installations Co. Ltd., 2-10 Valentine Pl, S.E.1.

BUSINESS PROSPECTS

Alton. Wessex Regional Hospital Board, Winchester, plan £25,581 Stage 2a of Lord Mayor Treloar Hospital extensions.

Barry. British Geon, Devonshire Hse, Mayfair Pl, W.1, plan major expansion of chemical plant.

Bedford T.C. School and training college planned at former Laxton nurseries. Engineer.—Geo. Wimpey plan development of former Laxton nurseries as private 400-house estate with shops.

Belfast. Young and MacKenzie, 2 Wellington Pl, Belfast, architects for the Scottish Widows' Fund and Life Assurance Society office building on site at junction High St/Lombard St.

Boldon U.D.C. Tender: 50 terraced houses, North Rd, Boldon Colliery. Surveyor.

Bolton. Goodyear Tyre and Rubber Co., Bushbury, Wolverhampton, plan tyre remould factory buildings at Manchester Rd industrial estate.

Boston T.C. 58 houses and 20 bungalows planned. Surveyor.

Bournemouth. Richmond Hill Printing Works plan factory extension, 23 Abbott Rd.—D. Drake and Son, Orchard St, Bournemouth, plan Wallisdown Rd factory. —Wessex Regional Hospital Board, Winchester, plan maternity unit at Firs Hospital. Contractors: Jenkins and Sons, 43 Holdenhurst Rd.

Bridlington. Rigg Holdings plan factory extension.

Burnley. Peter Nuttall, 5 Kay St, Rawtenstall, architect for St. Hilda's R.C. Secondary School extensions, phase 2.—Joseph Lucas plan £¼ million Eastern Ave factory. Tee and Gate, 43 Frederick Rd, Birmingham 15, architects.

Cardiff. Corporation Development Committee plan experimental flatted factory near city centre.

Carshalton. Surrey C.C. plans £50,000 old people's home at Wandle Mead. Architect.

Chatham. Farms and Ptnrs, 24 Welbeck Way, W.1, architects for printing works including offices and stores at 12 New Rd Ave, for Parrett and Neves.

Chatteris U.D.C. 12 bungalows planned on New Rd estate and block of bed-sitting room flatlets for old people. Surveyor.

Chesterfield T.C. Civil Defence headquarters and social centre to cost £20,000 planned for rear New Sq. Surveyor.

Chingford B.C. Tender: 16 flatlets. Engineer.

Coalville. H. Owen Luder, 79 Regency St, S.W.1, architect for £¼ million shopping centre for Triland (Property Holdings).

Colchester. £7,300 stage 7 of street lighting improvement planned.

Darlington. H. B. Richardson, 3 Skinnergate, Darlington, architect for North of England Newspaper Co.'s workshops and offices at Priestgate.

Doncaster T.C. Wholesale fruit and vegetable market planned. Surveyor.

Dudley. Clydesdale Stamping Co., Atlas Wks, Netherton, plan Yew Tree Hills dye store.

Durham. Sir Basil Spence, 1 Canonbury Pl, N.1, architect for £400,000 new women's college, St. Aidan's.

Ealing. Middlesex C.C. plan £20,000 Oldfield and Woodend community centre.

Easington. R.D.C. plan £7,528 improvement of electrical facilities to cover 2,000 houses.

Flint B.C. Tender: 39 bungalows, "Highfield," Bagillt. Engineer.

Glasgow. Walter Underwood and Ptnrs, 2 La Belle Pl, Glasgow C.3, architects for £100,000 two-storey store at Argyle St for Morrison's Associated Companies.

Gosport B.C. Tender: 24 one-bedroom flats, Water Police Quarters site, Trinity Green. Engineer.

Grimsby T.C. Two three-story flats block planned junction Bath St/Albion St, £32,091. Engineer.

Haltwhistle. Benson and Dixon, Fairhill, Haltwhistle, contractors for Smith and Walton's planned factory additions.

Hampshire. C. G. Stillman, 4 Fitzroy Park, N.6, architect for C.C.'s comprehensive health clinic, ambulance station, community centre, library and flats, probably at Havant.

Herefordshire. E.C. plans £¼ million grammar school near Fayre Oaks Cottage, King's Acre La.

Hounslow. Gula Investments plan six-storey office block with 35 ground floor shops on High St site.

Hull. F. Bilton, 83 Wincolmlee, Hull, contractors for £400,000 Kingston upon Hull Training College, Cottingham Rd.—J. H. Fenner and Co., Marfleet, Hull, plan research and development block, Marfleet Ave. —Reckitt and Sons plan additional floor to offices, Kingston Wks, Danson La.

Ipswich B.C. Tender: Stage 1, new secondary modern school, Chantry estate. Architects: Johns, Slater and Haward, 32 Foundation St, Ipswich.

Kettering. T. Wilson and Son, Sheep St, Northampton, plan 35 dwellings on housing site at Hall La.

Knaphill. New Ideal Homesteads, 61 South St, Epsom, Surrey, plan 260 houses at Hermitage and Inkerman roads.

Leamington Spa. Lewis and Watters, Lime Ave, plan 57 Parklands Ave houses.

Leeds. Jowett and Sowry, Albion St, plan £125,000 printing works, etc., Shannon St area. Architect: G. Alen Burnett, 8 Blenheim Terr, Leeds.

London. T. P. Bennett and Son, 43 Bloomsbury Sq, W.C.1, architects for 15-storey ward block at London Hospital, East Mount St, Stepney, E.1.—George Trew and Dunn, 50 Eastbourne Terr, W.2, architects for extensions of King's College Hospital, Denmark Hill, S.E.5.—Scherrer and Hicks, 27 Harcourt Hse, Cavendish Sq, W.1, architects for £443,000 reconstruction of Tudor Secondary School, Islington.—York, Rosenberg and Mardall, 2 Hyde Park Pl, W.2, architects for extensions to Southlands College, Wimbledon Park Side, S.W.19.—F. J. Broadbent and Ptnrs, 13 Manchester Sq, W.1, architects for Our Lady of the Rosary Convent in Crawford St. Cost: £150,000.—Maurice Sanders, 24 Harley St, W.1, architect for 19-storey office building with shops, restaurant, etc., on sites in London Wall, Winchester Ave, Wood St, etc., E.C.2.—A. Kenneth Lindy, Joseph Hill and Ptnrs, 24 St. Mary Axe, E.C.3, architects for six-storey office building, St. Mary Axe and Bevis Marks, E.C.—T. P. H. and E. Braddock, Orchard Hse, 14 Gt. Smith St, S.W.1, architects for multi-storey office building, Holborn Viaduct and Snow Hill. —R. Seifert and Ptnrs, 34 Red Lion Sq, W.C.1, architects for offices at 6 and 9 Rood La, E.C.—A. F. Westman, Cheapside, E.C.2, architect for nine-storey office building at 125 Wood St, etc., E.C.2.—Audley Properties, 1 Stanhope Gate, W.1, plan 13-storey block of studio flats, 38 Abercorn Pl, N.W.

Luton. H. F. Scriven, Bute St, Luton, plan workshop and offices, Duke St.

Lytham, Lancs. W. C. Evans and Co., Chadwick Rd, Eccles, Lancs, plan factory on part of former R.A.F. Camp, near Warton. Architects: Scherrer and Hicks, Harcourt Hse, Cavendish Sq, W.1.

Maidstone. New Thornhill Estates, Foley Hse, Sittingbourne Rd, plan three-storey block of 21 flats, Park Ave.—Manor Hall Ltd. plan 108 bungalows off Queen's Rd.

Manchester. Isaac Neild Co., 47 Market St, Manchester 1, plan 20 three-storey maisonnettes, Palatine Rd.—24 flats planned, Wilmslow Rd, Withington, by P. Hamer, Swinton, Manchester.

Mansfield. V. G. Yeomans, Westbank Ave, Mansfield, plan 37 Highfield Ave bungalows.—Scientific Building Contractors Ltd., Quarrydale Rd, Sutton-in-Ashfield, plan 25 houses and bungalows, Fairholme Drive.

March. Cromwell Development Co., Coventry, plan development of six-acre site near Badgeney Rd estate for 72 private houses and five shops.

Merseyside. Metal Box Co., Baker St, W.1, plan £1 million packaging factory on Wirral 15-acre site.

Milford Haven. Davis Estates, 346 Kilburn High Rd, N.W.6, plan 76 dwellings, Bunkers Hill estate.

Mitcham. J. F. Farquharson and Ptnrs, 34 Queen Anne St, W.1, structural consulting engineers for Shirley and Warbey Box Co.'s Christchurch Rd premises.

Newcastle. S. Maclean and Co., Hadrian Wks, Heaton Rd, plan extensions.—Educational Committee. Tender: Alterations and additions to Middle St Technical High School. Education Architect.—T.C. plan 125 houses, 12 flats and garages on Newbiggin Hall estate at £267,640 and £10,680 pavilion on King George playing field, Fenham.

New Mills. Rowlinson Construction Ltd., 249 London Rd, Hazel Grove, South Reddish, plan 142 dwellings, Mellor Rd.

Nottingham. Roman Catholic teachers' training college planned at £¾ million.

Oakengates. Gasel Ltd., Leonard St, Oakengates, plan factory extensions.

Oxford. Hospital Board, Banbury Rd, Oxford, plan £100,000 sick admission unit at Borocourt Hospital. Architects: Powell and Moya, 36 Gt. Smith St, S.W.1.

Peterborough. F. Perkins Ltd. plan extensions to Oxney Rd factory.—J. P. Hall and Sons plan extensions to Queen's Walk factory.

Plymouth. T.C. plans £22,000 Burrington factory for Cluett Peabody and Co.

Portsmouth. J. Cockerill and Son, 67 Commercial Rd, Portsmouth, plan £100,000 factory, St. George's Sq.

Sheffield. Hadfield, Cawkell and Davidson, 17 Broomsgrove Rd, Sheffield 10, architects for University's £390,000 third men's hall of residence.—Adams, Holden and Pearson, 38 Gordon Sq, W.C.1, architects for seven-storey radiotherapy centre, Whitham Rd, Broomhill.—Robert Neill and Co. (Sheffield), 28 Trippett La, Sheffield 1, plan offices on 598 sq yd site at Scotland St and Solly St.

Slough B.C. Tender: 236 dwellings, Parlaunt Park, Langley. Engineer.

Staines. Kelvin Construction Co., Long Drive, Greenford, Middx, contractor for £100,000 research laboratory at The Causeway, Staines, for Petters Ltd.

Stevenage. Farmer and Dark, Romney Hse, Tufton St, S.W.1, architects for £1 million factory for Bowater Paper Corporation Ltd.

Stockton-on-Tees. P. R. Middleton and Ptnrs, 111 Albert Rd, Middlesbrough, architects for £130,000 grammar school for Durham Diocese.

Torquay. Selectrics and Coinmechs, Meter Hse, Factory Row, Castle Circus, Torquay, plan factory and offices, Fore St.

Wallingford. Ministry of Works (Architects' Dept., Abell Hse, John Islip St, S.W.1) plan £200,000 extensions at Hydraulic Research Laboratories.

Watford. M. of Works plan £300,000 physics group buildings at D.S.I.R. Building Research Station, Watford.

Wednesbury. £1,800 Oxford St street lighting added to 1961-62 programme.

West Bromwich B.C. Tender: 184 maisonnettes. Architect.

Wilton, Wilts. Installation of street lighting to serve further development at Seagrim estate planned.

Windon B.C. Provision of traffic signals planned at Drove Rd/Groundwell Rd.

Wrexham B.C. Tender: (a) 66 dwellings, Montgomery Rd; and (b) 14 dwellings, Lorne St/Park St. Surveyor.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Abex Heating and Electrical Engineers Ltd., 59 Aylesbury St, Bletchley. Nom. cap.: £100. Dirs.: Leslie S. Hall and Cyril B. Coley.

Bendix Ericsson U.K. Ltd. To acquire the Instrument Division of Ericcson Telephones Ltd., as manufacturers of and dealers in electronic, electrical, nucleonic, mechanical, optical and hydraulic articles, components, systems, etc. Nom. cap.: £100,000. Dirs.: John H. Mitchell, 35 Lucknow Drive, Nottingham; Eric G. Monk, 15 De Vere Gdns, W.8; John H. Reed and Charles C. Tillinghast.

A. E. Bloore Ltd. To take over business of an engineering or electrical manufacturers carried on at Llanbedr by A. E. Bloore, etc. Nom. cap.: £5,000. Dirs.: Albert E. Bloore and Marjorie Bloore, Erw Fair, Llanbedr.

T. A. Boxall and Co. Ltd., 20 Balcombe Rd, Horley, Surrey. Electrical contractors, etc. Nom. cap.: £10,000. Permanent dirs.: Thos. A. Boxall and Elizabeth M. Boxall.

B.S.R. (Monarch Electric) Ltd. Electrical and general engineers, etc. Nom. cap.: £50,000. Dirs.: Daniel M. McDonald, Hammer Hill, nr. Bridgnorth, Salop; and Wm. L. Hewitt, Cedars Ave, The Paddock, Kingswinford, Staffs.

Datasonde Ltd. Instrument, electronic, electrical and mechanical engineers, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: J. S. Camp, 239 Holland Rd, Clacton-on-Sea; and D. B. J. Stevens, 36 Hatherley Rd, Sidcup.

Electric Appliances (Swansea) Ltd., 18a Castle St, Swansea. Nom. cap.: £100. Dirs.: Derek B. G. Wignall and Derek Dawson.

Electrosil Ltd. Importers and exporters of and dealers in and manufacturers of glass, glassware, glass products, etc. Nom. cap.: £25,000. Dirs.: not named. Subs.: Peter H. D. Ryder and Kenneth H. Chapman, 15 Curzon St, W.1.

El-Tronics Co. (Gt. Britain) Ltd., 22 Queen St, E.C.4. Manufacturers of and dealers in electronic and electrical components, etc. Nom. cap.: £1,000. Dirs.: Paul M. Kovany and Stuart J. Myers.

Esisolder Iron Co. Ltd., 9 Liverpool Gdns, Worthing. Electrical contractors and engineers, etc. Nom. cap.: £100. Dirs.: Reginald G. Rhode-Knight and Margaret Rhode-Knight.

Etablissements Hoover Societe Anonyme. British address: Perivale, Greenford, Middx. Registered in Republic of France in 1953, to manufacture and sell mechanical or electrical apparatus, etc. Capital: 600,000,000 francs. Name of person authorised to accept service: Harold G. Meads, Perivale, Greenford, Middx.

Fennells Electrical Ltd., 31 Queens Rd, Nuneaton, Warwicks. Manufacturers of and dealers in radio apparatus, etc. Nom. cap.: £5,000. Dirs.: Walter W. Fennell and Geoffrey J. Fennell.

J. and M. Greenwood Ltd., 367 Abergele Rd, Old Colwyn, Denbighshire. Electrical engineers, etc. Nom. cap.: £2,000. Dirs.: Maurice A. Greenwood, Charles Randle, Joan K. Greenwood and May G. Randle.

W. Groves Ltd., 9 Edward Rd, Birmingham 12. To take over the business of manufacturing electrical engineers carried on at Balsall Heath, Birmingham 12, by W. and Mrs F. I. Groves, etc. Nom. cap.: £3,000. Dirs.: Wm. Groves and Mrs F. I. Groves.

Tayfas Developments Ltd. To carry on business of civil, mechanical, electrical and general engineers, etc. Nom. cap.: £100. Dirs.: not named. Subs.: **John O. W. Flood,** 3 Vine Hse, Hampton Court Rd, Molesey, Surrey; and **Angus H. Taylor,** 15 Wavendon Ave, W.4.

Tele-Electric Wiring Ltd., 72 Leighton Rd, Ealing, W.13. Nom. cap.: £1,000. Dirs.: Reginald E. Sarro, John V. Sims and Leonard E. Sims.

A. J. Whetton Ltd. Electrical engineers, etc. Nom. cap.: £6,000. Dirs.: to be appointed by subs. Subs.: Arthur J. Whetton, 7 Fairoak Drive, S.E.9; and Harry S. T. Penning, 15a Winchester Ave, N.W.6.

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

G.D.S. Rentals Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 16 Jan. Persons intending to appear to notify Kinch and Richardson, 180 Fleet St, E.C.4, by 1 p.m., 14 Jan.

Albert Miller and Co. (Southport) Ltd. Petition for winding-up to be heard before the County Court of Liverpool, Fifth Floor, India Bldg, Water St, on 6 Jan. Persons intending to appear to notify Cuff Roberts and Co., 34 Castle St, Liverpool 2, by 6 p.m., 5 Jan.

R. Summers (Devon) Ltd. Mr R. A. Hawken, Bank Chmbrs, 1 John St, Bedford Row, W.C.1, and Mr G. A. Wale, Walter Hse, 418-422 Strand, W.C.2, appointed liquidators at extraordinary general meeting on 28 Nov.

E.W.D. (Electrics) Ltd. Mr P. Cardwell, 93 Queen St, Sheffield 1, appointed liquidator as from 7 Dec.

Pearl Industries Ltd. Creditors to send details to liquidator: P. R. Hackett, 18 Greenfield Cres, Birmingham 15, by 15 Jan. Formal notice: all creditors to be paid in full.

Ice Queen Refrigerators Ltd. Meeting of creditors to be held at offices of Radford, McColl and Co., 12 Portland St, Southampton, on 22 Dec., at 2.30 p.m.

United Sewing Machines (Mayfair) Ltd. General meetings of members and creditors to be held at offices of S. G. Banister and Co., 15 Golden Sq, W.1, on 5 Jan., at 11.45 a.m. and 12 noon, respectively.

Arthur C. Symons Ltd. Mr T. J. Woods, 39 Hermitage Rd, Hitchin, Herts, appointed liquidator at extraordinary general meeting on 25 Nov.

Fenn Electrical Ltd. Mr R. A. Hawken, Bank Chmbrs, 1 John St, Bedford Row, W.C.1, and Mr G. A. Wale, Walter Hse, 418-422 Strand, W.C.2, appointed liquidators at extraordinary general meeting on 28 Nov.

Pool Electrics (Blackpool) Ltd. Mr. J. L. Hague, Bank Chambers, 7 South King St, Blackpool, appointed liquidator at extraordinary general meeting on 17 Nov. for the purpose of voluntarily winding-up.

Leslie's Electricals Ltd. Mr. H. I. Tibury, 112 Crescent Rd, Reading, appointed liquidator at extraordinary general meeting on 14 Nov. for the purpose of voluntarily winding-up.

Ideal Electrics (Middlesbrough) Ltd. Mr. R. W. Hellyer, Brotherton Chambers, Westgate, Leeds 1, appointed liquidator as from 18 Nov.

Leamington Electrical Installations Ltd. Mr. R. F. Bendall, 126 Colmore Row, Birmingham 3, appointed liquidator at extraordinary general meeting on 21 Nov. for the purpose of voluntarily winding-up.

Don Electrical Co. Ltd. Creditors to send details to liquidator: P. Cardwell, 93 Queen St, Sheffield 1, by 31 Dec.

Treforest Electrical Services Ltd. General meeting to be held at offices of South Wales Switchgear, Blackwood, Mon, on 30 Dec., at 10.30 a.m., for the purpose of having an account of the winding-up laid before the members.

H. V. Colman and Co. (Electrical Contractors) Ltd. Liquidator: W. Le'Resche Hand, Colmore Hse, 21 Waterloo St, Birmingham 2, released as from 21 April.

Mead and Jeffery Ltd. Mr R. A. Hawken, Bank Chmbrs, 1 John St, W.C.1, appointed liquidator as from 23 Nov.

BANKRUPTCY ACTS

Receiving Orders

Bridgwater. L. A. James, radio and electrical engineer, carrying on business as Domestic Electrics, at 42 Clare St. Receiving order dated 8 Dec.

Nottingham. T. K. Underwood, radio, television and appliance retailer, formerly carrying on business in partnership as Fourways Electrical Services, at 68 Carter La, Mansfield, and 18 Market Pl, Shirebrook. Receiving order dated 9 Dec.

Macclesfield. C. Powell, electrical engineer, carrying on business as Cooke and Co., at Station Rd, Wilmslow. Receiving order dated 6 Dec.

Oldham. A. Myers, salesman and electrical appliance mechanic, of 102 Greenwood St. Receiving order dated 7 Dec.

Public Examinations

Edmonton. L. Smith, electrical retailer, carrying on business as Smiths Electrics of 134 Chase Side, Enfield. Public examination: 10.30 a.m., 21 Feb., at Court Hse, Fore St, N.18.

Leeds. J. W. McEvoy, electrical appliance dealer, carrying on business as Domestic Electrics at 246 Easterly Rd. Leeds 8. Public examination: 10.30 a.m., 14 Feb., County Court Hse, Albion Pl, Leeds 1.

Application for Discharge

High Court of Justice. G. W. May, electrician, formerly carrying on business at 2a First St, Chelsea. Order made. on 4 Nov., on application for discharge: Discharged as from 4 Nov., 1961.

Rescinding Order

Rochester. C. E. Purcell, electrical contractor, formerly carrying on business as E. Purcell and Son, at 13 Wrotham Rd, Gravesend. Rescinding order dated 17 Oct.: all debts paid in full.

MEETINGS TO NOTE

FRIDAY, 30 DEC.

A.S.E.E. (Coventry and District). "Development of Electrical Equipment for Machine Tools." J. N. Leah. E.M.E.B. Sports and Social Club, Merrick Lodge, Sandy Lane. 7.30 p.m.

MONDAY, 2 JAN.

I.E.E. (S. Midlands). Discussion: "Broadening University Courses." Joint meeting with Education Discussion Circle. James Watt Memorial Institute, Birmingham. 6.30 p.m.

PLASTICS INSTITUTE. "Plastics and Textiles." H. A. Thomas. Institution of Electrical Engineers, Savoy Pl. London W.C.2. 2.30 p.m.

I.E.S. (Birmingham). Display of lighting fittings. Bennett Hall, Y.M.C.A., Snow Hill. 6 p.m.

TUESDAY, 3 JAN.

I.E.E. (N. Midlands). "Water-Turbine-Driven Induction Motors." C. L. C. Allan. Leeds and County Conservative Club, South Parade, Leeds. 6.30 p.m.

WEDNESDAY, 4 JAN.

I.E.E. (Southern). "The Planning and Economics of Telecommunication Plant." C. J. Stubbington. The University, Southampton. 7 p.m.

I.E.E. (Sheffield). Christmas Holiday Lecture: "Colour Television," R. Feinberg. City Hall, Sheffield. 3 p.m.

I.E.E. (Tees-side). "The Fylingdales Early Warning Station." D. R. Evans. Cleveland Scientific and Technical Institution, Middlesbrough. 6.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Radar Group). "Automatic Techniques in Civil Air Line Communications Systems." W. E. Brunt. London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 6.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (S. Yorks). "Instruments and Cherry Blossom—Some Impressions of a Technical Visit to Japan." W. C. Heselwood. University, St. George's Sq, Sheffield 1. 7 p.m.

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For any task requiring from 1/25th to 600 h.p., put both your minds at rest. BROOK offer a wide range of electric motors and good technical advice on how best to use them.

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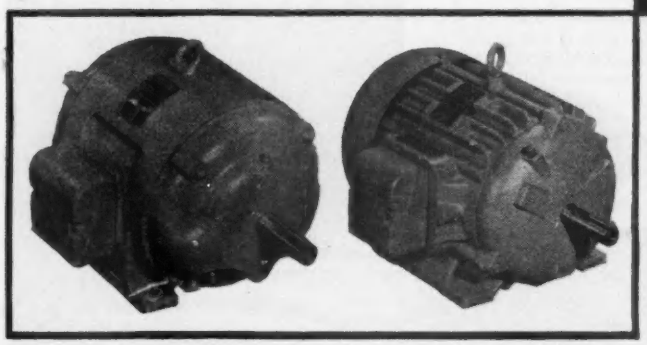

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Flowing lines of light . . .
'Sky-Line'...in single, elegant fittings or coupled in flowing lines for hotels, stores, supermarkets, offices and all commercial areas.
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CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

Port-of-Spain (Trinidad) 'B' Power Station Extension

Registration of Contractors

The Commission intend to make substantial extensions to the existing Power Station in Port-of-Spain. The civil engineering works will be executed by a fixed rate type contract and it is expected that the works will begin in the first half of 1961.

The major civil engineering works will include:

1. Steel framed structure.
2. Foundations for buildings, boilers and turbo-alternators.
3. Cooling water culverts and drain.
4. Pumping station.
5. Associated and miscellaneous building work.

The approximate estimated cost of these works is W.I. $5 million (W.I. $4·80=£1).

Application for Registration Forms should be made to the Consulting Engineers to the Commission, Howard Humphreys and Sons, Standard Life Bldg, 1 Edward St, Port-of-Spain, or to their London Office, 8 Francis St, Westminster, London S.W.1. The closing date for the issue of Registration Forms is 21 Jan., 1961.

Completed Registration Forms should be forwarded in accordance with instructions contained therein to:

The General Manager,
Trinidad and Tobago Electricity Commission,
P.O. Box 121,
Port-of-Spain, Trinidad W.1.

The closing date for the receipt of such forms is 4 Feb., 1961. (T 161)

BOROUGH OF DROITWICH

Street Lighting—District Roads

TENDERS are invited from experienced contractors for the supply, delivery and erection of 52 No. Street Lamps in District Roads, together with wiring, lanterns and auxiliary gear.

Conditions of Contract and plan may be inspected at, and Specification, Bills of Quantities and Form of Tender obtained from the Borough Engineer and Surveyor, Town Hall, Droitwich, during normal office hours upon payment of a deposit of £2 2s, which sum will be returned on receipt of a bona fide tender and the return of all documents.

Tenders, in plain sealed envelopes, endorsed "Street Lighting—District Roads," to be delivered to the undersigned not later than 10 a.m. on Monday, 2 Jan., 1961.

The Council do not bind themselves to accept the lowest or any tender.

S. G. FOSTER,
Town Clerk.

Town Hall,
Droitwich,
Worcs.
6 Dec., 1960. (T 135)

WEST LANCASHIRE RURAL DISTRICT COUNCIL

Street Lighting

THE Council invite tenders for the supply, erection and commissioning of 55 Class "A" positions using 140 W sodium discharge units mounted on concrete columns, and 527 Class "B" positions using M.F. lamps mounted on concrete columns; to be erected in the various parishes of the Rural District.

Tenders may be submitted for any or all of the following three sections:

(a) Supply of concrete columns and brackets.

(b) Supply of transformers, capacitors, discharge lamps and lanterns.

(c) Erection of columns and brackets, fitting and wiring of electrical equipment fuses and all requisites not supplied in (a) or (b), removal of redundant equipment and putting the completed installation into commission.

Specification, bills of quantities, schedule of positions and form of Tender may be obtained from the Engineer and Surveyor, West Lancashire Rural District Council Offices, Derby St, Ormskirk, on payment of a deposit of £2 2s, which will be refunded on receipt of a bona fide tender not subsequently withdrawn. Plans may be inspected at the above Council Offices.

Sealed tenders in plain envelopes marked "Street Lighting" must be delivered to the undersigned not later than 12 noon on 9 Jan., 1961.

Wm. RIGBY,
Clerk of the Council.

Council Offices,
52 Derby St,
Ormskirk,
Lancashire. (T 163)

GHANA SUPPLY COMMISSION

Tenders for Supply of Electric Cables

THE Ghana Supply Commission invite manufacturers to submit tenders for the following:

Tender Reference	*Description*
ELEC. 4023/1	61,000 yards Low Voltage Underground Cable, various sizes.
ELEC. 4024/1	29,000 yards High Voltage Underground Cable, various sizes.

Forms of tender and Condition of Contract are obtainable as from 15 Dec., 1960, on payment of a fee of £G1 from The Secretary, Ghana Supply Commission, Post Office Box M.35, Accra, Ghana. The closing date for receipt of tenders will be 23 Jan., 1961. (T 157)

APPOINTMENTS VACANT

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER
(SUBSTATION MAINTENANCE)

READING District of No. 2 (Newbury) Sub-Area. Salary: N.J.B. Class J, Grade 7 (£1,275/£1,410 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance of plant and equipment at outdoor and indoor substations on

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continued from previous column

both urban and rural systems and to undertake standby duties. Candidates should have experience of the commissioning and maintenance of plant and equipment up to, and including, 33 kV and should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1298, not later than 2 Jan., 1961.

ASSISTANT ENGINEER (PLANNING)

Reading District of No. 2 (Newbury) Sub-Area. Salary: N.J.B. Class J, Grade 10 (£1,040/£1,165 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist the Planning Engineer in the preparation of schemes and estimates for extensions of and reinforcement to overhead and underground H.V. and L.V. networks, and to undertake standby duties, if required. Applicants should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1297, not later than 2 Jan., 1961.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (T 175)

COUNTY BOROUGH OF BOOTLE

SENIOR ASSISTANT ENGINEER
(ELECTRICAL AND MECHANICAL)

APPLICATIONS are invited from suitably experienced and qualified persons for the above position in the Borough Engineer and Surveyor's Department.

The appointment is subject to the National Scheme of Conditions of Service and the successful candidate, who should possess the Higher National Certificate in Electrical Engineering or other approved qualifications, will be required to take responsibility for all Electrical work including heating, ventilation, lighting and other work of similar character.

The salary will be in accordance with Grade APT.III, £960/£1,140 per annum.

Applications, on forms obtainable from the Borough Engineer and Surveyor at the address below, with the names of two referees, should be delivered to him not later than noon on Friday, 6 Jan., 1961.

HAROLD PARTINGTON,
Town Clerk.

Town Hall,
Bootle 20,
Lancs. (T 176)

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

TWO THIRD ASSISTANT ENGINEERS

(a) LUTON DISTRICT
330/60N.

(b) HENDON DISTRICT (Ref. 1023)
331/60R.

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems, including substations.

Salary: N.J.B. (a) Class J, Grade 9 (£1,115/£1,245): (b) Class G, Grade 9 (£965/£1,090), plus London Allowance for (b).

Apply by letter, by 6 Jan., 1961, to:

(a) W. G. Tree, Manager, Luton District, Eastern Electricity Board, 487 Dunstable Rd, Luton.

(b) F. A. Moinet, Manager, Eastern Electricity Board, 137-139 Brent St, Hendon. (T 171)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER
CROYDON AND PURLEY DISTRICT

SALARY: £1,165/£1,295 per annum, including London Allowance under N.J.B. Agreement, Class J, Grade 9. Superannuable.

Applicants should be suitably qualified and have operational experience of maintenance and construction on distribution system up to 11 kV. Candidates should also have experience of planning work.

Applications, quoting ET and naming two referees, on forms from District Manager, Seeboard, Electric Hse, Wellesley Rd, Croydon, by 4 Jan., 1961.

ASSISTANT DISTRICT ENGINEER
CROYDON AND PURLEY DISTRICT

Salary: £1,325/£1,460 per annum, including London Allowance under N.J.B. Agreement, Class J, Grade 7. Superannuable.

Applicants should be suitably qualified and have responsible experience of maintenance on distribution system equipment up to 11 kV. Candidates should also have experience of construction and planning work up to the same voltage.

Applications, quoting ET and naming two referees, on forms from District Manager, Seeboard, Electric Hse, Wellesley Rd, Croydon, by 4 Jan., 1961.

ASSISTANT DISTRICT ENGINEER
WEST KENT DISTRICT

Salary: £875/£990, including London Allowance, under N.J.B. Agreement, Class G, Grade 11. Superannuable.

Applicants should have technical qualifications up to H.N.C. standard with training and experience in the construction, operation and maintenance of underground and overhead distribution systems up to 11 kV.

Applications, quoting ET and naming two referees, on forms from District Manager, Seeboard, 286 High St, Orpington, Kent, by 4 Jan., 1961.

ASSISTANT DISTRICT ENGINEER
SEVENOAKS AND REIGATE DISTRICT

Salary: £1,115/£1,245 per annum under N.J.B. Agreement, Class G, Grade 7. Superannuable.

Applicants should be suitably qualified and have responsible experience of maintenance on distribution system equipment up to 11 kV. Candidates should also have experience of construction and planning work up to the same voltage.

Applications, quoting ET and naming two referees, on forms from District Manager, Sevenoaks and Reigate District, Seeboard, Electric Hse, West Hill, Oxted, Surrey, by 4 Jan., 1961.

ASSISTANT DISTRICT ENGINEER
CENTRAL SUSSEX DISTRICT

Salary: £890/£1,015 per annum under N.J.B. Class F, Grade 9. Superannuable. Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground and overhead distribution systems. The successful candidate may elect to have a service tenancy of a Board flat.

Applications, quoting ET and naming two referees, to the District Manager, Seeboard, Electra Hse, Church Rd, Haywards Heath, Sussex, by 4 Jan., 1961.

GEORGE WRAY,
Secretary.
(T 166)

THE NORWICH CITY COLLEGE AND ART SCHOOL
IPSWICH ROAD, NORWICH, NOR 67D.

Principal:
Frank Briers,
B.Sc., D.Phil.(Oxon.), F.R.I.C.

LECTURER IN ELECTRICAL ENGINEERING

TO commence duties on 1 Jan., 1961, or as soon as possible thereafter. Applicants should be well qualified and should have had industrial and teaching experience. The range of courses in which the successful candidate may be required to teach includes work up to the I.E.E. Part III requirements. Salary: £1,370 x £35—£1,550.

Application forms, obtainable from the Director of Education, City Hall, Norwich, NOR 01 A, on receipt of a stamped addressed envelope, should be sent to the Principal as soon as possible. (T 164)

CENTRAL ELECTRICITY GENERATING BOARD
London Division

APPLICATIONS are invited for the following superannuable posts. Salary includes London Allowance.

CHEMICAL ASSISTANT
ACTON LANE POWER STATION
VACANCY No. 60/1006.

Candidates should have as minimum G.C.E. in English, Maths., Physics and Chemistry. Day release, in approved cases, up to age 21 for further study. Duties include work in laboratory and on power station plant. Salary rising to £855 per annum.

CHEMICAL ASSISTANT
FULHAM POWER STATION
VACANCY No. 60/1007.

Candidates should have as a minimum G.C.E. in English, Maths., Physics and Chemistry. Day release, in approved cases, up to age 21 for further study. Duties include work in laboratory and on power station plant. Salary rising to £855 per annum.

Applications, quoting vacancy number, may be made on the standard form obtainable locally and sent to the Personnel Officer, Central Electricity Generating Board, London Division, P.O. Box 136, Generation Hse, Great Portland St, London W.1, to be received not later than 3 Jan., 1961. (T 168)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

North Staffs Sub-Area

SECOND ASSISTANT
(COMMERCIAL ENGINEERING DEPARTMENT)
(NEWCASTLE-UNDER-LYME)

The successful applicant will be required for sales promotion duties, and should have a sound commercial experience, including a thorough knowledge of modern sales methods and techniques and should be capable of organising sales campaigns and sales promotion activities designed to develop the sale of electrical appliances. Duties will include the supervision of Service Centres, Demonstrators and Sales Representatives. Appropriate qualifications desirable. Salary: £965/£1,090 per annum (N.J.B. Grade F.8). Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr C. C. Pimble, Sub-Area Manager, Midlands Electricity Board, 234 Victoria Rd, Fenton, Stoke-on Trent.

Shropshire & Herefordshire Sub-Area

THIRD ASSISTANT DISTRICT ENGINEER
(SHREWSBURY)

Applicants should have had experience in the construction and maintenance of high and medium voltage distribution system. Technical qualifications desirable. Salary: £825/£940 per annum (N.J.B. Grade E.9). Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary, to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gdns, Ditherington, Shrewsbury.

South Staffs and North Worcs Sub-Area

SECOND ASSISTANT DISTRICT
COMMERCIAL ENGINEER (STOURBRIDGE)

Applicants should have had a sound technical training with wide practical experience in the sale and installation of domestic and commercial electrical equipment and the work associated therewith. The successful applicant will be required to assist in all branches of commercial work including advising consumers on domestic, commercial and industrial equipment, estimating and contracting work. Technical qualifications desirable. Salary: £965/£1,090 per annum (N.J.B. Grade F.8). Apply, by letter, within

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14 days, stating age, qualifications, experience, present position and salary to Mr H. A. P. Caddell, Sub-Area Manager (Ref. EMI/SEC), Midlands Electricity Board, P.O. Box No. 9, Toll End Rd, Tipton, Staffs.

Wolverhampton & District Sub-Area

GENERAL ASSISTANT DISTRICT
COMMERCIAL ENGINEER
(WOLVERHAMPTON)

Applicants should have had a sound technical training and experience in all branches of commercial work. Technical qualifications desirable. Salary within the ranges £715/£805, £765/£870 or £825/£940 per annum (N.J.B. Grades J.15, J.14 or J.13), according to qualifications and experience. Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary, to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

F. W. CATER,
Secretary.
(T 170)

THE SOUTH WALES ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEERS

APPLICATIONS are invited for the following positions in the Cardiff and East Central Area:

(a) STAFF VACANCY NOTICE No. 184/60
(Re-advertised)

General Assistant Engineer, Rhondda District. Salary: N.J.B. Class F, Grade 11, Scale 4 (£765/£870 per annum).

(b) STAFF VACANCY NOTICE No. 219/60.

General Assistant Engineer, Cardiff District. Salary: N.J.B. Class J, Grade 11, Scale 7 (£965/£1,090 per annum).

Preference will be given to Engineers possessing a Higher National Certificate in Electrical Engineering.

Applications stating age, present position, present salary, qualifications and experience should be addressed to C. L. Townsend, ASSOCIATE I.E.E., Manager, Cardiff/and East Central Area, 445-447 Cowbridge Rd East, Cardiff, to arrive not later than 11 Jan., 1961. Please quote reference (a) 184/60/ET or (b) 219/60/ET, endorsing envelope "General Assistant Engineer."

R. G. WILLIAMS,
Secretary.
(T 172)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Stirling Area

DEMONSTRATORS
(Vacancy 85/60)

REQUIRED for Bathgate, Falkirk and Stirling Districts.

Applicants should possess a recognised Diploma or Certificate for Domestic Science and be capable of giving public lectures and demonstrations, advising consumers on the use of electrical apparatus and affording general assistance in the Board's Service Centres.

N.J.C. conditions. Salary: Grade 1, £600/£700 per annum. The posts are superannuable.

Applications, on the standard form obtainable from Area Manager, S.S.E.B., "Woodlands," St. Ninians Rd, Stirling, should be submitted not later than 27 Dec., 1960. (T 160)

CHARTERED ELECTRICAL ENGINEER

A VACANCY exists for a Chartered Electrical Engineer with a hydro-electric power undertaking in Northern Nigeria. Pleasant climate, 4,000 ft above sea level. Age 30 to 35. Salary grade £1,335/£1,565 according to age, qualification and experience. Pension and life assurance scheme. Eighteen months' tours with three months' leave on full salary. Free furnished quarters. Free passages self, wife and two children, or equivalent benefits if children remain at home. Write Box E.996, c/o Streets, 110 Old Broad St, E.C.2. (T 128)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

GENERAL ASSISTANT ENGINEER (CHEMIST)
NORTH WILFORD POWER STATION
Vacancy No. 273/60.

APPLICATIONS are invited for the position of General Assistant Engineer (Chemist) at North Wilford Power Station, Queens Drive, Nottingham.

Candidates must have had a sound technical training and previous laboratory experience and should preferably hold the Higher National Certificate in Chemistry, but consideration will be given to candidates studying for that qualification.

The salary will be within the range £625/£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications: 30 Dec., 1960.

GENERAL ASSISTANT ENGINEER (CHEMIST) (MALE OR FEMALE)
WILLINGTON POWER STATION
Vacancy No. 274/60.

Applications are invited for the position of General Assistant Engineer (Chemist) (Male or Female) at Willington Power Station, P.O. Box 27, Derby.

Candidates must have had a sound technical training and previous laboratory experience and should preferably hold the Higher National Certificate in Chemistry, but consideration will be given to candidates studying for that qualification.

The salary will be within the range £625/£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications: 30 Dec., 1960.

STATION SHIFT CONTROL ENGINEER
DERBY POWER STATION
Vacancy No. 275/60.

Applications are invited for the position of Station Shift Control Engineer at Derby Power Station, Full St, Derby.

Applicants should have had a sound technical training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be an advantage.

Salary will be in accordance with Class F, Grade 10 (£825/£940 per annum) of the National Joint Board Agreement, plus shift allowance.

Closing date for receipt of applications: 30 Dec., 1960.

PLANT SHIFT CONTROL ENGINEERS
WILLINGTON "A" POWER STATION
Vacancy No. 277/60.

Applications are invited for the positions of Plant Shift Control Engineers at Willington "A" Power Station, P.O. Box 27, Derby.

Applicants should have had a sound technical training and experience of the operation of a power station, including electrical control room experience. Preference will be given to candidates who possess technical qualifications to Higher National Standard, and experience of pulverised fuel firing will be an advantage.

Salary will be in accordance with Class L, Grade 10 (£1,190/£1,325 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 6 Jan., 1961.

GENERAL ASSISTANT ENGINEER (CHEMIST)
HIGH MARNHAM POWER STATION
Vacancy No. 278/60.

Applications are invited for the position of General Assistant Engineer (Chemist) at High Marnham Power Station, Newark, Notts.

Candidates should possess the Ordinary minimum qualification, and should have National Certificate in Chemistry as a previous experience in the analysis and testing of coal, water and oil, preferably in a power station laboratory.

The salary will be within the range £625/£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications: 6 Jan., 1961.

continued in next column

continued from previous column

ASSISTANT SHIFT CHARGE ENGINEER
HIGH MARNHAM POWER STATION
Vacancy No. 279/60.

Applications are invited for the position of Assistant Shift Charge Engineer at High Marnham Power Station, Newark, Notts.

Applicants should have had a sound technical training and practical experience in a large modern power station. Preference will be given to candidates with qualifications leading to Corporate Membership of the Institution of Electrical or Mechanical Engineers.

Salary will be in accordance with Class M, Grade 8 (£1,440/£1,610 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 6 Jan., 1961.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent concerned and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.
(T 177)

THE EAST MIDLANDS ELECTRICITY BOARD

Ilkeston & North Derbyshire Sub-Area

Vacancy No. 139/60.
SECOND ASSISTANT DISTRICT ENGINEER
MATLOCK DISTRICT

SALARY: N.J.B. Class F, Grade 7, £1,040 x £25—£1,165 per annum.

The duties will include assisting with the planning of underground and overhead distribution systems, including the layout of substations and the preparation of schemes on voltages up to and including 11 kV.

Applications should be forwarded to the Manager, Matlock District, "Glendon," Knowleston Pl, Matlock, Derbyshire, within 14 days of the date of this advertisement.

Coventry Sub-Area

Vacancy No. 143/60.
SENIOR ASSISTANT (STORES ACCOUNTS)

Salary: N.J.C. Grade 4, £890 x £30—£1,010 per annum.

The successful applicant will be responsible to the Principal Assistant (Expenditure) for stores recording methods, stores ledger controls including liaison with the Hollerith Machine Section, stock levels and reviews of slow moving stocks, collaboration with technical officers in operating standard stocks and the preparation of information for the General Accountancy Group.

A good appreciation of accountancy principles is essential and the possession of the Intermediate examination of a recognised professional body would be an advantage.

Applications should be forwarded to the Manager, Coventry Sub-Area, Sandy La, Coventry, within 14 days of the date of this advertisement. (T 182)

SOUTH WESTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following position:
THIRD ASSISTANT DISTRICT ENGINEER (PLANNING)
WEST CORNWALL

Salary according to Class G, Grade 9, Salary Scale 7, £965/£1,090 per annum of the N.J.B. Agreement.

The successful candidate will be required to assist in the planning work of a large, mainly rural, distribution system, together with the preparation of Capital Applications and estimates. The person appointed will be required to undertake standby duties.

A sound knowledge of construction methods and of all types of plant and equipment is necessary. Possession of the Higher National Certificate in Electrical Engineering is desirable, and possession of a current driving licence will be an advantage.

Applications to be made on Standard Form AE6/ACT, OBTAINABLE BY POST-CARD ONLY from the District Manager, South Western Electricity Board, 13 Basset Rd, Camborne, Cornwall. Closing date for receipt of applications is 7 Jan., 1961. (T 180)

A FIRST-CLASS JOB IN THE G.P.O.

Men between the ages of 20—35 are required to work in Central London on installing and maintaining telephone apparatus and transmission equipment. Older men, up to the age of 45, will be accepted if they have the experience which is particularly suitable.

Commencing pay is £9 16s per week rising to £12 2s.

Men who show ability to progress will be given every opportunity to qualify for Technical Officer posts on which the salary is £600 a year rising to £850. Further promotion is available.

Apply in writing stating age and experience to:

Chief Regional Engineer
(Ref. S/D2A(X2)),
London Telecommunications Region,
Waterloo Bridge House,
Waterloo Road,
London, S.E.1. (T 14)

AN experienced OUTSIDE SALES REPRESENTATIVE, of good education and with a sound electrical background, is required by Crompton Parkinson Ltd. to sell their Induction Motors on his own initiative in the Hull area.

This is a staff appointment, carrying a good salary and pension benefits.

Please apply for application form to MA/P2, Crompton Hse, Aldwych, London W.C.2. (T 179)

BRITISH Engine Boiler and Electrical Insurance Co. Ltd., 98 West George St, Glasgow C.2. ELECTRICAL SURVEYOR required for Scotland. Permanent position carrying progressive salary scale, £825/£1,225 with non-contributory pension. Candidates aged 26 to 32, with H.N.C. in Electrical Engineering or Grad. I.E.E. and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply stating age, qualifications and experience. (T 184)

G.E.C.

has vacancy for a

SENIOR TEST ENGINEER

in their Power Plant Division based at Erith, Kent.

This will involve efficiency testing and performance investigation of large turbo-alternator, blower and compressor plant in the U.K. and overseas, together with submission of test reports. Applicants should have had thorough experience in this field.

The post promises good prospects for a man with initiative and determination.

Apply in writing, giving full particulars of age, education and experience to Personnel Manager (E.C.D.), The General Electric Co. Ltd., Erith, Kent. (T 162)

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Due to expansion in the industrial applications field this Company has a vacancy for a SENIOR ENGINEER in the Industrial Application Section of the Electrical Rotating Machines Engineering Department. A knowledge of drives in the rubber, plastics and associated industries and of related control systems is essential. Some practical experience of site testing and commissioning is also desirable.

Applications are invited from fully qualified men and preference will be given to corporate members of the Institution of Electrical Engineers.

Applications, WHICH WILL BE TREATED IN THE STRICTEST CONFIDENCE, should contain brief details of experience and qualifications and should be addressed to Mr P. A. McCaig, quoting reference : PL.9904.

Brush Electrical Engineering Company Limited,
Loughborough, Leicestershire

(T 134)

DEVELOPMENT ENGINEER AND ASSISTANT, engineer to take charge of a Heater Development Laboratory, after a short initial period. Able to see design through from inception to quantity production with minimum supervision. O.N.C. (Electrical) minimum, but a higher qualification is desirable, together with some years' practical experience of small appliances, and a sound knowledge of elementary physics. Assistant O.N.C. standard. Send details and qualifications, experience, positions held, present salary, etc., to the PERSONNEL MANAGER, E. K. COLE LTD., MALMESBURY, WILTSHIRE. (T 118)

DRAUGHTSMAN, Electrical, with experience in switchboard and fusegear design. A.E.S.D. rate and superannuation. Write stating full particulars to Artic Fuse and Elec. Mfg. Co. Ltd., Birtley, Co. Durham. (T 173)

ELECTRICAL ENGINEER required for Glasgow Office staff, age 23-28. Applicants (H.N.C. minimum) should have had experience in the manufacture of electrical machines. Progressive salary with non contributory pension. Applications stating age, nationality, qualifications and experience to British Engine Boiler and Electrical Insurance Co. Ltd., 98 West George St, Glasgow C.2. (T 183)

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

West Indian Engineers who are interested in careers with the Trinidad and Tobago Electricity Commission are invited to write to the Secretary, P.O. Box 121, Port of Spain, Trinidad, West Indies. There are good opportunities for young West Indian Nationals with degrees in Electrical Engineering or who hold Higher National Certificates in Electrical Engineering or who are Graduate Members of the Institution of Electrical Engineers. Commencing salary £1,050 per annum. Experience not necessary, but candidates *must* be qualified. (T 47)

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ASSISTANT CONTROL ROOM OPERATORS

required

Under Railway Electrical Conditions to assist in the operation of the Electrical Control Room at Romford. Applicants should have served a recognised apprenticeship and possess knowledge of E.H.T. and L.T. distribution systems, isolation procedure and safety precautions. Shift working involved. Rate of pay: £12 2s per week of 44 hours, plus shift allowance 33s. Enhanced pay for overtime and Sunday duty. Applicants required to undergo medical examination. Certain free and reduced rate rail travel facilities. Pension and sick pay schemes. Prospects of promotion. Apply in writing, giving age, apprenticeship and experience to the Electric Traction Engineer (London Area), British Railways, Eastern Region, off Ley St, Ilford, Essex. (T 129)

ELECTRICAL ENGINEER required for maintenance and construction work by a large industrial organisation in Jamaica, W.I. Applicants should have had at least five years' experience of industrial maintenance and electrical installation work in a supervisory capacity. Send applications giving full details and salary required to: Reynolds Jamaica Mines Ltd., Lydford P.O., Jamaica, W.I. (T 181)

FOREMAN ELECTRICIAN required to take charge of all Electrical Plant and Installations at Bold Venture Wks, Chatburn, nr. Clitheroe. Staff appointment. Pension Scheme. House available. Apply in writing: Horrocksford Lime Co. Ltd., Clitheroe, Lancs. (T 185)

REPRESENTATIVE required by leading electrical wholesaler for Essex. Also London vacancies. Must be experienced and well connected in industry.—Halsey's, Brandon Hse, Wyfold Rd, Fulham, S.W.6. Fulham 3355. (T 169)

SENIOR ASSISTANT ELECTRICAL ENGINEER required by Consulting Engineers in London W.1 area; capable of complete design and control of large and small electrical installation contracts. Commencing salary in the scale £1,250/£1,500 per annum, plus luncheon vouchers. Successful applicant would be expected to join the Superannuation Scheme.—Box No. 8117, Electrical Times. (T 167)

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WANTED for prompt cash, ferrous and non-ferrous SCRAP: also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (T 1)

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(*Continued on page 34*)

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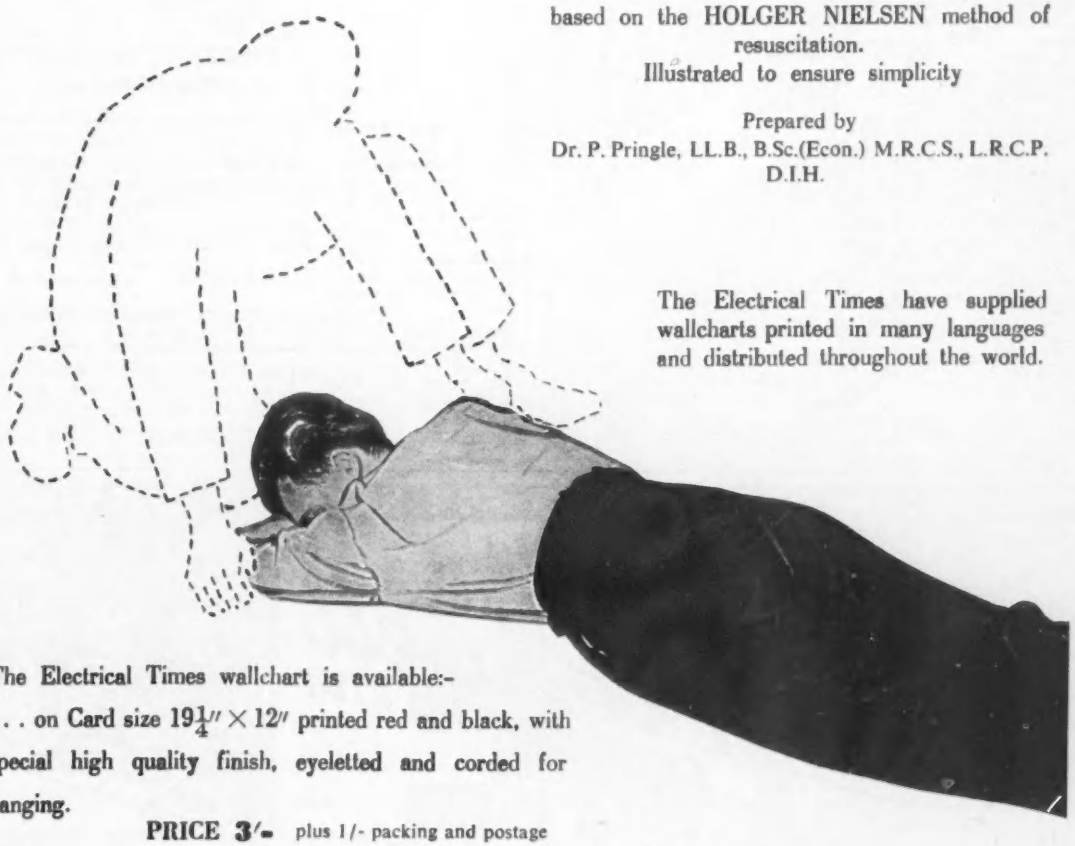

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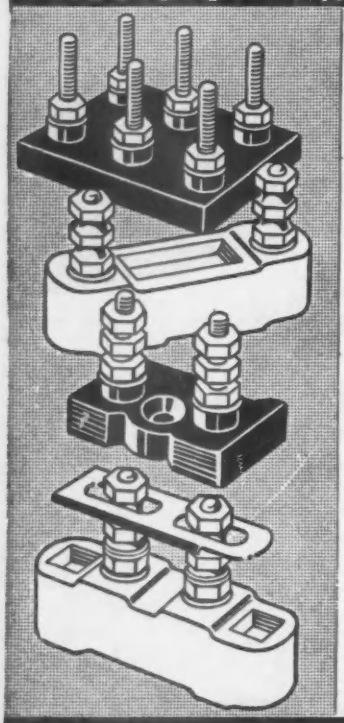

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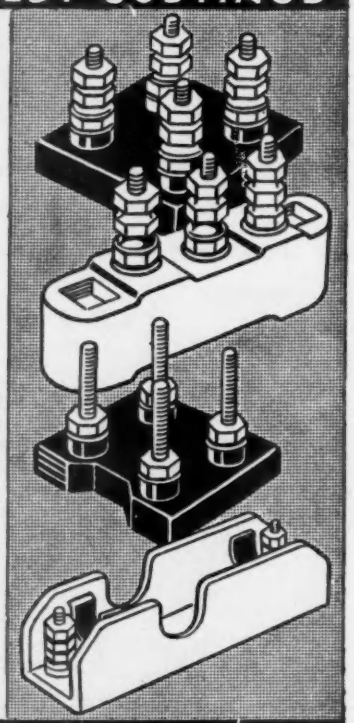

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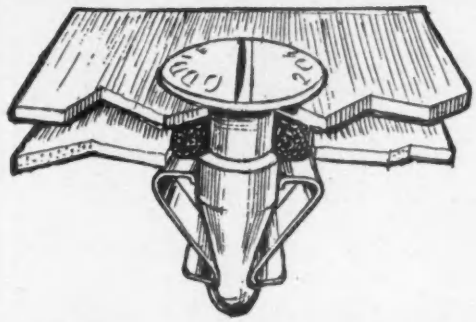

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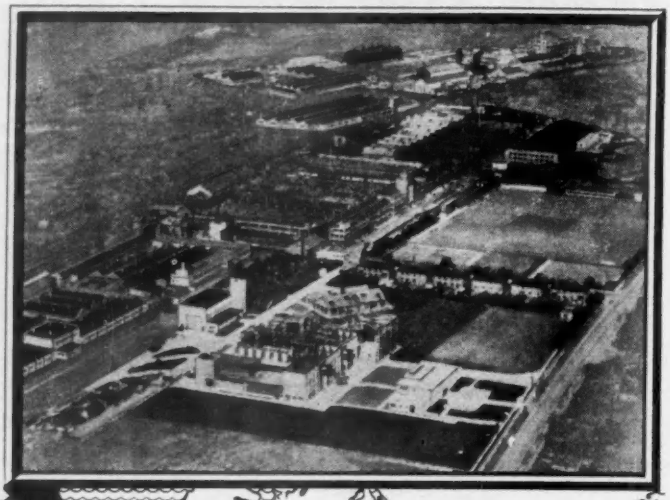

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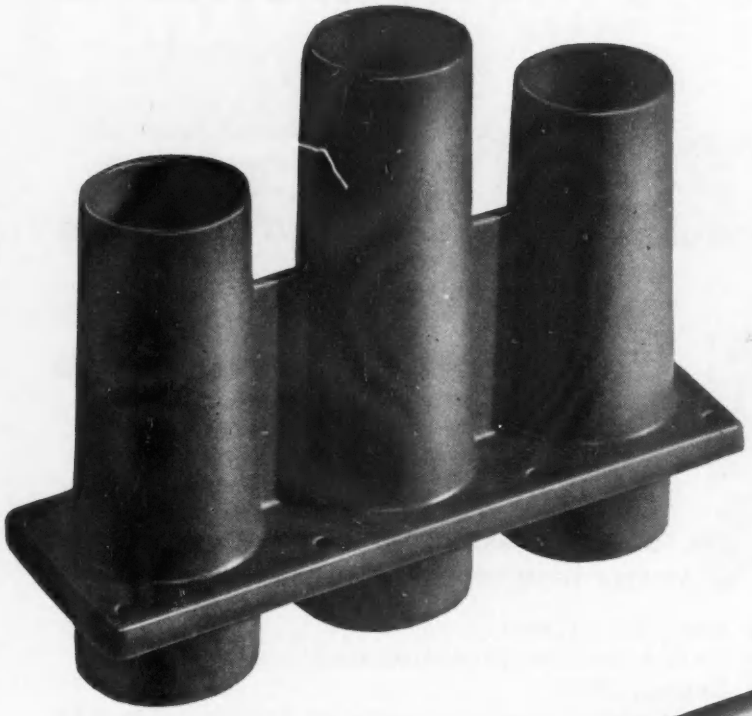

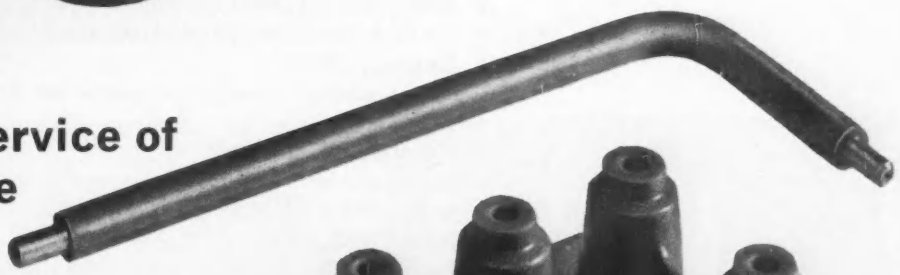

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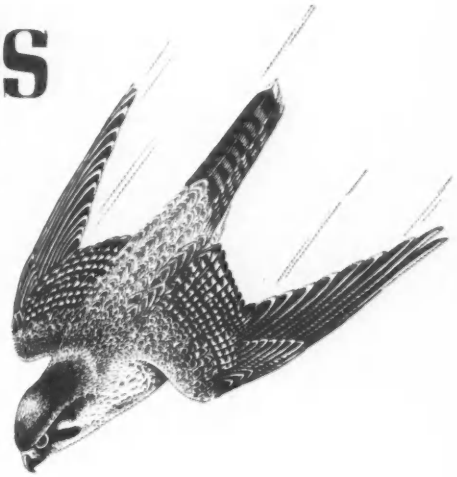

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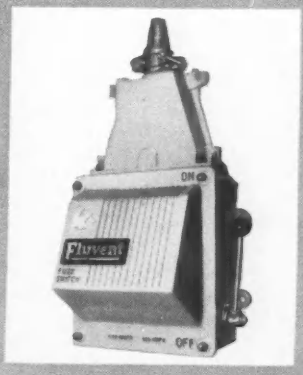

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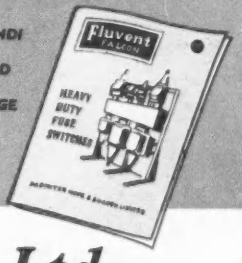

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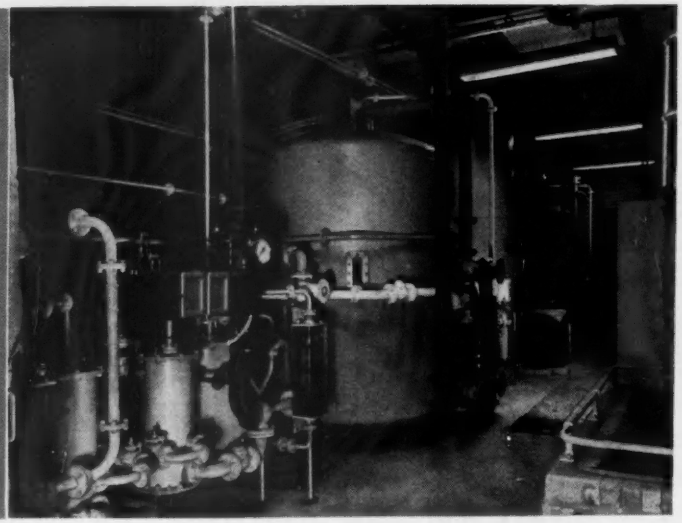

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